MINING CONGRESS JOURNAL

OVEMBER, 1940

OFFICIAL

PUBLICATION

In 1941 *it's*

18th Annual COAL
CONVENTION AND
EXPOSITION

April 28-May 2
CINCINNATI

8th Annual METAL
MINING CONVENTION
AND EXPOSITION

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MINING CONGRESS JOURNAL

Vol. 26 NOVEMBER, 1940 No. 11

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Preparation of Utah Coal, Castlegate Plant of Utah Fuel Company
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By L. C. Moore

New Developments in Placer Mining
By Herbert A. Sawin and Chas. M. Romanowitz

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Mining Geology Today
By Ira B. Joralemon

Sick Absenteeism
By Andrew Fletcher

Administering the Wage-Hour Act
By Col. Philip B. Fleming

Watch for It

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Opinions expressed by authors within these pages are their own, and do not necessarily represent those of the American Mining Congress

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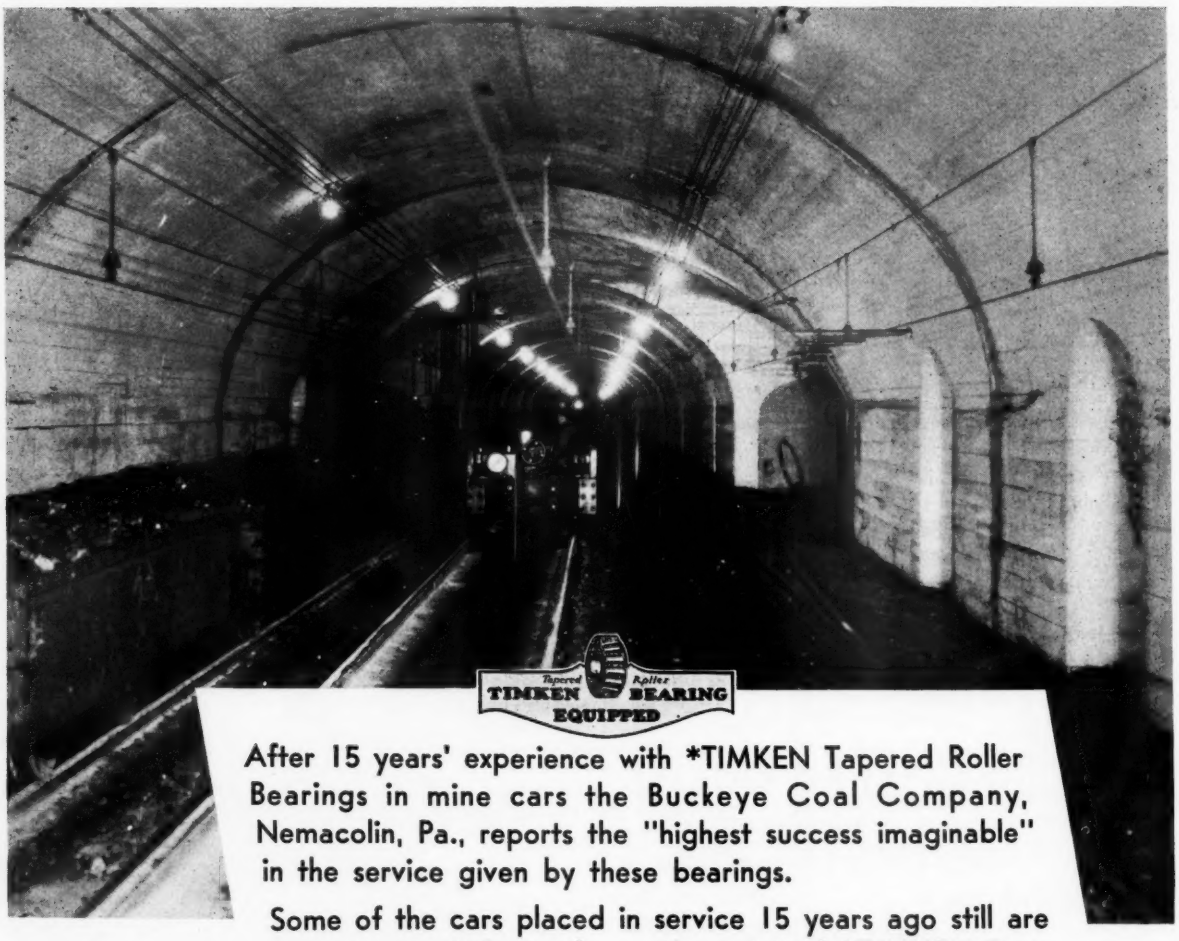
The Buckeye Coal Company Operates 1,500 Timken Bearing Equipped Mine Cars



Trip of Timken Bearing Equipped mine cars at the Buckeye Coal Company.

After 15 years' experience with *TIMKEN Tapered Roller Bearings in mine cars the Buckeye Coal Company, Nemacolin, Pa., reports the "highest success imaginable" in the service given by these bearings.

Some of the cars placed in service 15 years ago still are operating satisfactorily on the original *TIMKEN Bearings. Bearing replacements—from all causes—have been very few.

This company is one of more than 1,000 mine operators using Timken Bearing Equipped mine cars. Over 300,000 mine cars in all have gone on TIMKEN Bearings during the last 20 years. Make sure *your* new mine cars have them.

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Manufacturers of TIMKEN Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; TIMKEN Alloy Steels and Carbon and Alloy Seamless Tubing; and TIMKEN Rock Bits.

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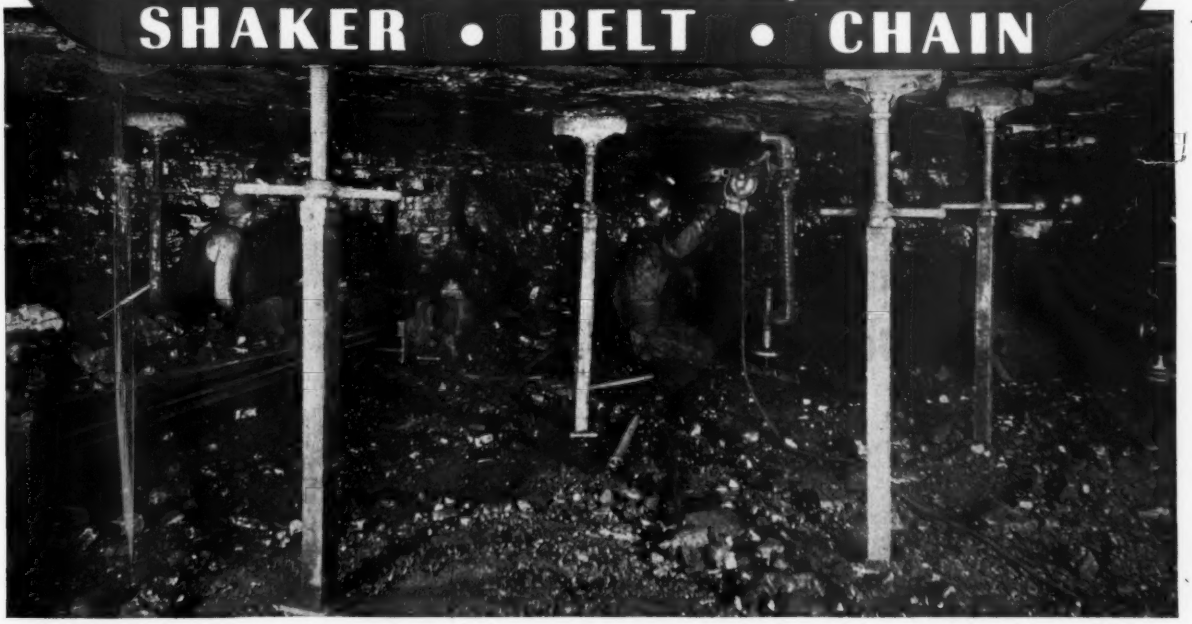
TIMKEN
TAPERED ROLLER BEARINGS

GOODMAN CONVEYORS

The Goodman line of shaker, belt and chain conveyors includes such a wide variety of designs that there is a type or combination of types which will produce the best possible results in any set of conditions.

SHAKER • BELT • CHAIN



The use of shaker conveyors permits the overlapping of preparation and loading. Note the simultaneous cutting, drilling and loading operations pictured here. 10903

11181

The discharge end of a Goodman shaker drive. The coal on the pan line has been loaded by a duckbill.

11031

Coal loaded by a duckbill and moved by a shaker conveyor from face to entry is being discharged onto a Type 97 troughed belt conveyor.

Your copy of our new Conveyor Equipment Bulletin CM-391 will be sent on request.

GOODMAN

MANUFACTURING CO. • HALSTED ST. AT 48TH, CHICAGO, ILL.

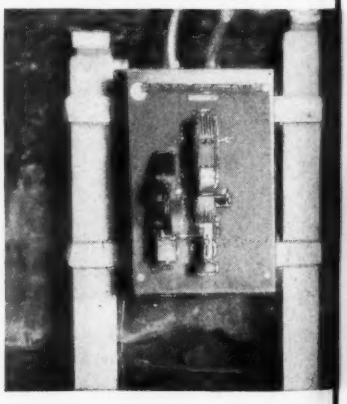
NOW IS THE TIME FOR

These G-E Products Are Tonnage Boosters—and They May Cost You Nothing because of What They Save

IN LOOKING ahead to higher tonnages, you'll no doubt be considering such points as the elimination of bottlenecks in moving the coal, new equipment to cut the number of shutdowns for repairs and maintenance, and the speeding up of operations generally.

In this connection, the General Electric equipment shown on these pages is well worth your serious attention. It illustrates how you can gain many of your objectives electrically—gain them with the aid of the complete G-E line and the help of our mining specialists. Our local representative will be glad to go underground with you and look over your requirements. For further information about the products shown on these pages, write to the nearest G-E office. General Electric, Schenectady New York.

FORMEX-WOUND D-C MOTORS—For added assurance of continuous operation, G-E d-c mine motors now have Formex magnet wire on their main field coils and are, therefore, able to withstand the mechanical shocks and overheating that may be produced on the underground electrical circuits. Formex has high dielectric strength, and is remarkably tough, flexible, and resistant to abrasion. It shows no tendency to become brittle, crack, or lose its toughness on long exposure to heat. (Bulletin GEA-2973.)

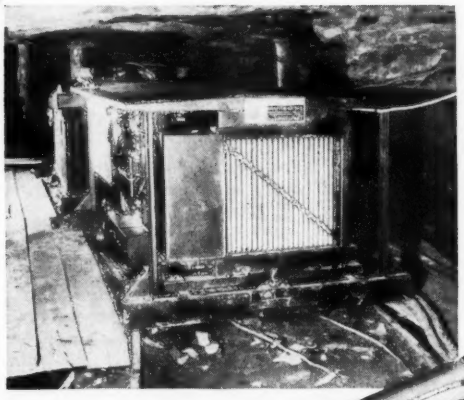


SWITCHGEAR—Type AE-1 air circuit breakers, installed wherever sectionalizing is advisable, provide the protection so necessary to high-tonnage production. They have high interrupting capacity, and protect against short circuits and prolonged overloads. Depending upon the arrangement of the underground circuits, they may be a safeguard for the mine should a rockfall cause a trolley-wire break. (Bulletin GEA-3468.)

Cost-cutters—for

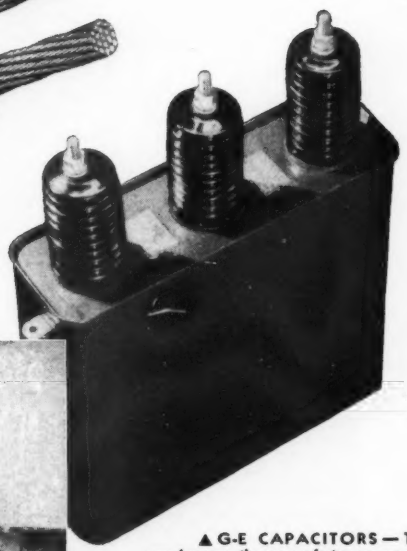
GENERAL

AN ELECTRICAL CHECKUP

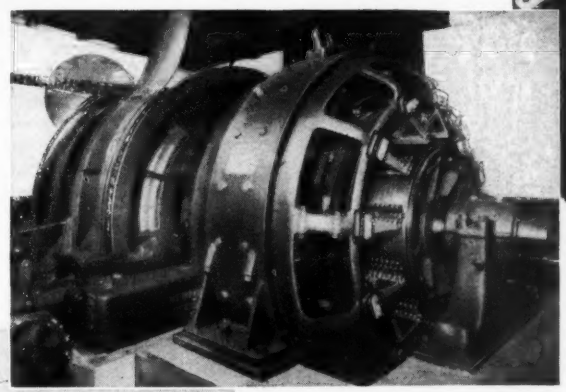


PORTABLE-SUBSTATION EQUIPMENT—To maintain production with d-c equipment, the voltage at the mine face must be up. G-E portable substations are mounted on wheels and can be easily moved on the track. Their mobility greatly simplifies the problem of keeping your substation at the load center and maintaining the proper voltage at the face. Rectifier substation shown. (Bulletin GEA-2756.)

TELLURIUM CABLE—It's tough, hard to cut, and stands up under rough usage. That's why its use with shovels, cutters, loaders, drills, and motors means a reduction of outages and lost time, as well as savings in repairs and replacements.



▲ G-E CAPACITORS—They can improve the power-factor on your a-c circuits, in tipple or washery, for example, and, by so improving voltage conditions, make possible important operating benefits—improved starting conditions, prevention of unnecessary motor shutdowns, and sometimes remarkable reductions in power costs. (Bulletin GEA-3225.)



▲ G-E HOIST EQUIPMENT—High-speed electric hoists mean more tons raised to the surface per hour. G-E motors and control, backed by the experience of G-E engineers in applying them to hoist service, enable you to meet the requirements of fast, smooth, dependable operation at a point that may be the bottleneck of the entire mine. (Bulletin GEA-1593.)

G-E MINE LOCOMOTIVES—New locomotives will enable you to gather and haul more coal in less time and at lower cost. For example, the amazing new 15-ton locomotive shown at the left is only 26 inches high—nine inches lower than any previous locomotive with equal weight and power. In low coal that means removing nine inches less top and bottom, and an enormous reduction in tunneling cost. (Bulletin GEA-3459.)

high-speed, low-cost production

E L E C T R I C

ANOTHER DU PONT DEVELOPMENT

...the DU PONT REG. U. S. PAT. OFF. Superior Crimper

Makes a WATERPROOF joint between blasting cap and fuse!

DIMENSIONS:
Width: (base) 4½ ins.
Height: 10 ins.
Weight: 10 lbs.

The Du Pont Superior Crimper is a new bench-type cap crimper recently developed by Du Pont Engineers.

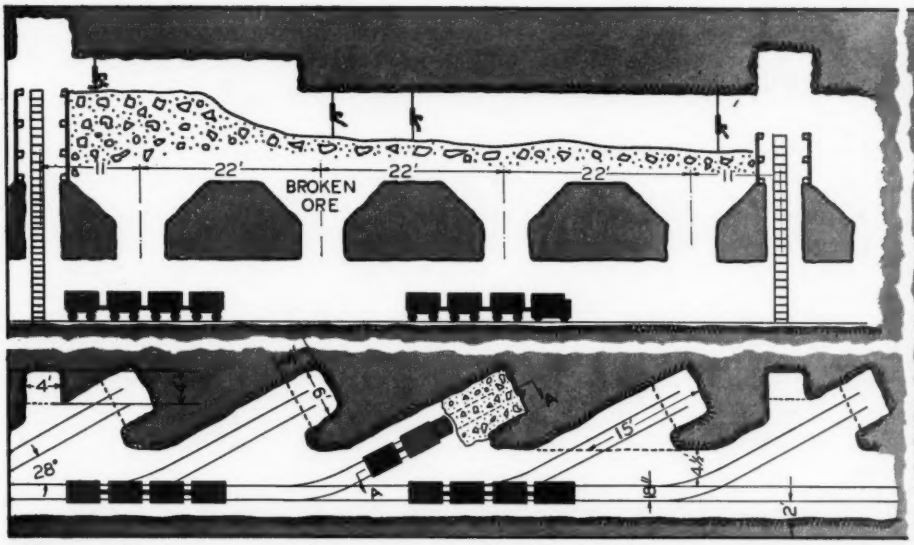
The crimp made by the Superior Crimper is not like the sleeve or segment type. It consists of two smooth continuous internal beads on the throat of the cap. These beads grasp the covering of the fuse so closely that a waterproof seal is made without the use of a waterproofing compound. Practical tests have demonstrated that the Du Pont Superior Crimper makes a joint more waterproof than the fuse itself.

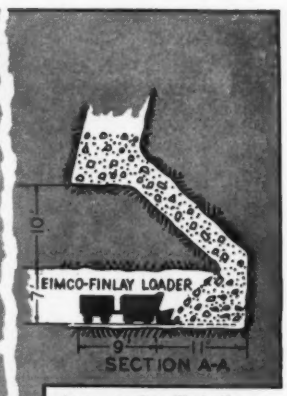
In operation, the Du Pont Superior Crimper is mounted on a bench. The freshly cut end of fuse is inserted in the cap as far as possible, and then pushed into throat of crimper until it stops. Operating the handle once makes the two crimps as shown.

The Du Pont Superior Crimper works either by foot treadle or hand. The crimper is adjustable to crimp any length of commercial cap, and is equipped with a fuse cutter.

This new crimper is still *another* example of Du Pont pioneering and leadership—to help you conduct your blasting with greatest possible efficiency and economy. E. I. du Pont de Nemours & Co. (Inc.), Explosives Dept., Wilmington, Delaware.

DU PONT EXPLOSIVES *and* BLASTING ACCESSORIES





Accompanying illustration, reproduced by courtesy of Black Hawk Cons. Mines Co. shows their cross-cut method of operation. When raises are run directly from haulage ways it is usually desirable to use double track, and to provide chain gates for checking flow of ore when not loading.

Save time and money by loading out of shrinkage stopes with EIMCO-FINLAY LOADERS

In many mines big savings are now being achieved by allowing ore to run down out of shrinkage stopes onto the floor of cross-cuts or haulage ways, from where it is loaded directly into cars by one or more Eimco-Finlay Loaders. Some of the many advantages secured are listed below:

1 Elimination of the timbering, bins, gates, chutes, grizzlies and sub-levels required for loading directly into cars. These draw-control set-ups are not only expensive to install, but often even more expensive to keep in good condition.

2 Elimination of delay in opening up ore-bodies, heretofore required for installing chutes, gates, grizzlies, etc. By the Eimco method you simply shoot the ore down and start loading it into cars.

3 Larger extraction openings can be used, thereby reducing danger of the ore flow being stopped because of clogging or piping.

4 Less blockholing (secondary blasting) is required. When loading, any pieces to be blockholed can be rolled to one side on the floor of the cross-cut and broken later. Safety is promoted because blockholing is done in a relatively small and confined area.

5 Extraction openings can be filled with rock, to suit the mining operation, and loaded out as desired.

6 Ore can be loaded out much more rapidly and economically. One mine recently reported loading 178 cars in six hours with a Model 12-B Eimco-Finlay Loader.

7 Maintenance cost of stopes, and general overhead expense, is reduced because stopes can be cleaned out much sooner.

8 Danger of injuries, or casualties, to men loosening ore in extraction openings is very largely eliminated.

Other money-saving methods of using Eimco-Finlay Loaders in modern mines and tunnels are illustrated and described in our new 36-page bulletin No. 105. Write today for your free copy.

Loading out of shrinkage stope with an Eimco-Finlay Loader at the Lake View and Star Mine, Kalgoorlie, Australia.

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History devotes volumes to Alexander's military exploits but hardly notes his greatest contribution to civilization. Yet Alexander underwrote the first great inventory of the world's knowledge. Expeditions he financed prospected every part of the then-known world to gather specimens of every type of flora, fauna and mineral . . . to observe and record every code of ethics, religion and government.

When Alexander gave Aristotle 800 talents for research (today approximately $25,000,000), he could hardly have foreseen that this world's first

AND FOUNDER OF RESEARCH

endowment of organized factfinding would lay the foundation of scientific knowledge for more than a thousand years to come. Yet in one decade, through the work of over a thousand field men exploring the Near East and Asia, knowledge was expanded and correlated on a scale never since duplicated.

To measure the magnitude of this work, consider the terrific limitations surrounding Alexander's

AMERICAN CYANAMID COMPANY

grant. Of all our research equipment only the compass and the ruler were then known. With no mechanism of experiment with which to work, the best Aristotle could do was to send expeditions into the field to observe the world as they found it.

Having no knowledge of electrical phenomena or conditions of chemical combination; no understanding of the nature of gravity, pressure, heat or combustion; no scientific background to guide them, it is astounding that the reports of these pioneer field men were so accurate. Yet this vast body of data and specimens became the cornerstone of the famous Museum of Alexandria where Euclid, Eratosthenes, Appolonius, Hero and Archimedes postulated many basic scientific principles.

History remembers Alexander as a military genius, yet he diverted a goodly share of his kingdom's wealth to underwrite organized knowledge. History portrays Aristotle as a dreamy metaphysician, but he must also have been a highly practical research director. For the principle of sending trained men into the field to gather and correlate for the benefit of all men, what individuals in far places have independently evolved, is still eminently sound.

Cyanamid Service to Metallurgy has always looked beyond the development of reagents and their efficient manufacture to their most effective use in the mill. For years Cyanamid Field Men have worked with mill metallurgists in every mining field of the world to develop exactly the right combination of reagents and processes for highest recovery at lowest cost. Sometimes this work involves the services of the Chemical, Physical and Microscopical Departments of the Cyanamid Ore Dressing Laboratory or even the development of a new reagent to solve a peculiar problem.

But quite often the best place to do test work is in the mill itself where reagent combinations can be tried under actual operating conditions. In helping with this work Cyanamid Field Engineers bring you their cumulative experience gained in working on many problems in many fields on all types of ore. You will find them always willing to give their enthusiastic cooperation in verifying present flow schemes, or testing new combinations of chemicals and processes. We invite you to make full use of Cyanamid Service to Metallurgy.

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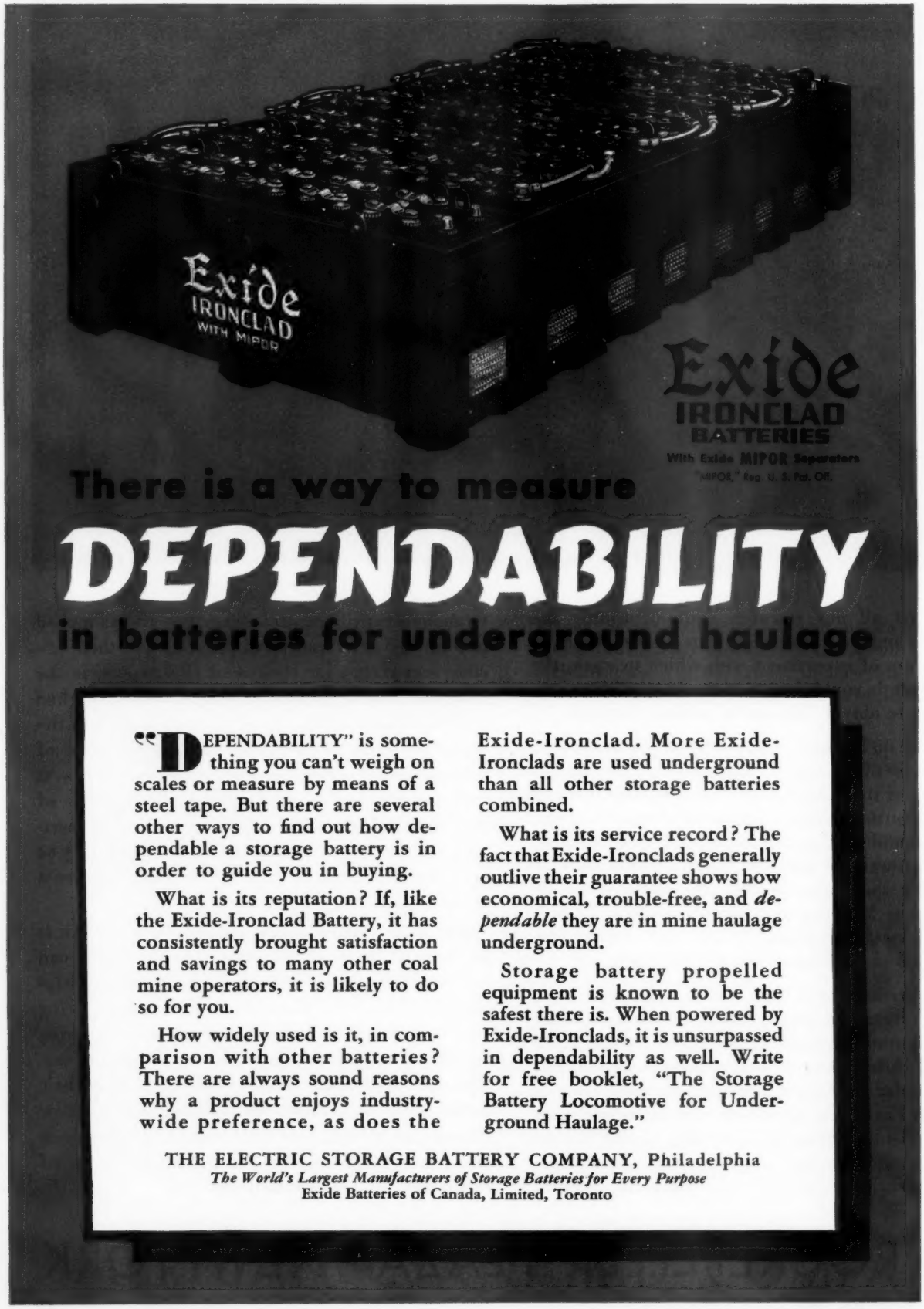


There is a way to measure

DEPENDABILITY

in batteries for underground haulage

"DEPENDABILITY" is something you can't weigh on scales or measure by means of a steel tape. But there are several other ways to find out how dependable a storage battery is in order to guide you in buying.

What is its reputation? If, like the Exide-Ironclad Battery, it has consistently brought satisfaction and savings to many other coal mine operators, it is likely to do so for you.

How widely used is it, in comparison with other batteries? There are always sound reasons why a product enjoys industry-wide preference, as does the Exide-Ironclad. More Exide-Ironclads are used underground than all other storage batteries combined.

What is its service record? The fact that Exide-Ironclads generally outlive their guarantee shows how economical, trouble-free, and *dependable* they are in mine haulage underground.

Storage battery propelled equipment is known to be the safest there is. When powered by Exide-Ironclads, it is unsurpassed in dependability as well. Write for free booklet, "The Storage Battery Locomotive for Underground Haulage."

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia
The World's Largest Manufacturers of Storage Batteries for Every Purpose
Exide Batteries of Canada, Limited, Toronto

A JOURNAL FOR THE ENTIRE MINING INDUSTRY—PUBLISHED BY THE AMERICAN MINING CONGRESS

MINING CONGRESS JOURNAL

Vol. 26 NOVEMBER, 1940 No. 11

UNDER GUISE OF DEFENSE

LAST spring the Administration apparently abandoned efforts to consummate a treaty on the St. Lawrence Seaway and Power Project. It appeared at that time that all attempts had been frustrated by protests from taxpayers, industry, labor and also from the Canadians themselves. None of these could be won over to a joint expenditure of $1,120,000,000 from which harm rather than benefit was to be expected.

Disregarding the fact that in 1934 the United States Senate rejected a similar treaty, certain Administration forces have continued to make a fetish out of Federal construction and operation of such hydro-electric power projects. Now comes the most recent move in the appointment by the President of a special committee to consider power development of the International Rapids section of the St. Lawrence. From the defense funds given him by Congress, the President has allocated a million dollars to the Corps of Engineers for study and preliminary tests, alleging that power from this particular project is needed for the national defense program.

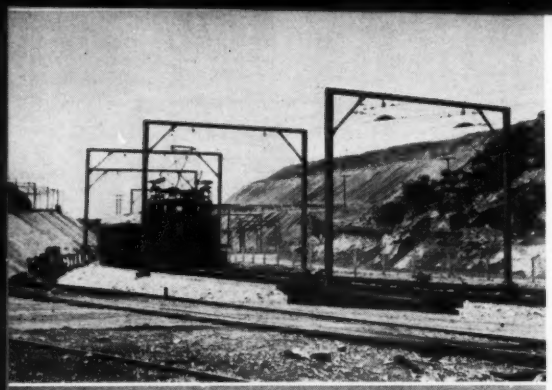
Realizing that it would take from five to six years before electrical energy could be forthcoming from such a project, it certainly seems a far cry from the present emergency but it is not difficult to realize that by such *rex et imperator* procedure much more than $1,000,000 of our national defense money may go into the St. Lawrence project. It is well to remember that the Panama Canal, estimated to cost $160,000,000 actually cost $375,000,000; the Chicago Canal, estimated to cost $16,000,000, cost $53,000,000; and the Suez Canal, estimated to cost $30,000,000, cost $80,000,000.

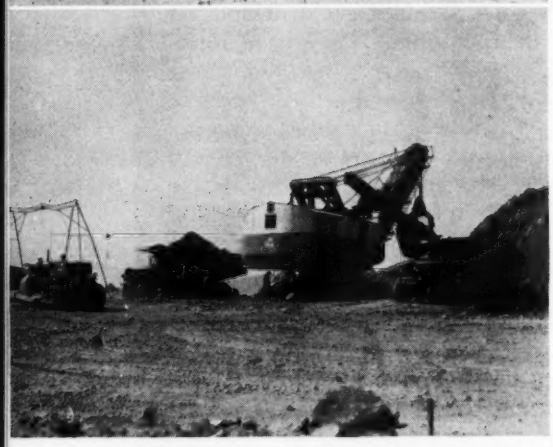
The St. Lawrence Valley is the classic route for armed invasion of the heart of industrial America. This hydro-power project leading inevitably to a seaway development is a menace to the economic balance of the mines, manufacturers, railroads, shipping and the people of the Great Lakes Basin. The issue is not new, it has been in controversy for years. Most certainly no action should be taken without the orderly consideration of Congress. The citizens of our free country should not be foreclosed in the exercise of their right of petition through the initiation by anyone of a questionable and costly project without the specific authorization of Congress.

ESSENTIAL TO DEFENSE

FOR the past three or four years any man engaged in productive enterprise or contemplating new ventures has been fearful of Federal taxation policies. However, such men have consistently said that a menace of far deeper concern to them lies in the attitude of the present administration on labor relations, as evidenced by the unbridled conduct of the NLRB and its irresponsible staff. The vicious and deadly persistence with which this group of men, with the support of many Federal officials, has sought to drive a wedge of estrangement between managements and their workmen is nothing short of appalling. They have recklessly engendered class hatreds without cause and without thought of consequences, pressing their unwanted activities into fields and industries where distrust and strife are totally foreign to the mutual regard and respect which have always existed between industrial managers and workmen.

In the October issue of this Journal the address delivered by Edmund M. Toland details enough of the findings of the Congressional Committee investigating the National Labor Relations Board to prove the highly improper, if not actually subversive nature of the perpetrations of this administration-sponsored board and its staff. Untold harm has been wrought in the mining fields through the influences touched upon by Mr. Toland in his address at the Mining Congress' Metal Mining Convention in Colorado Springs, and unless these unwarranted practices are quickly stopped, American industry will sink to the disastrous level of France. The distractions conveniently provided by the war and national defense turmoil have led the public mind away from the malpractices of the NLRB, and the corrective amendments overwhelmingly approved by the House of Representatives have been permitted to lie unacted upon in the obstructive Senate Committee on Education and Labor. As a first step in an effective national defense program these amendments must be quickly enacted.





Upper—85-ton electric locomotive. Steel posts and cross beam for double track haulage, Chino open pit

Center—Diesel electric locomotive with waste train, Morenci open pit. Locomotive is 125 tons 1,000 H.P. 12 cylinder Diesel engine, maximum speed 60 m.p.h.

Lower—45-ton trucks and bulldozer serving a shovel at Morenci open pit

New Developments and Equipment in METAL MINING†

By ROBERT S. LEWIS*
* Professor of Mining
University of Utah, Salt Lake City

TO a great extent it may be said that revolutionary changes in mining methods and equipment have been superseded by continued improvements, refinements and adaptations of methods and of equipment to the specific problems at hand. In many instances the changes over the past two years may be collectively described as trends. Caught between the pinching jaws of decreasing grade of ore and more difficult conditions of operation on the one hand, and higher costs of labor, materials and taxes on the other hand, any change that will increase unit output or reduce unit cost, even though slightly, is not passed by with the thought that only radical improvements should be given consideration.

Ground Support Problems

A very serious problem is that of ground support. As mining is carried to greater depths the effect of either not supporting or of improperly supporting the upper workings becomes cumulative and has serious consequences later in the form of rock bursts or crushes or the need for intensified artificial support. Fayol's theory of doming is now an important principle to apply in studying subsidence. Two stopes with a pillar between may be roughly likened to two consecutive arches. If the intervening abutment or pillar is too small it eventually gives way and one large arch is formed by the merging of the two smaller stopes through progressive sloughing of their backs until the new large arch is sufficiently high to be self-supporting. Increased weight is consequently brought on the abutments of this new arch.

Also a new opening, as a deep drift, is thought to be surrounded by rings of stress, much as though metal hoops were imbedded in the walls and were contracting to force the wall rock into the drift. Support of this theory is found in the fact that sloughing of the walls in deep drifts or levels has been lessened or stopped where cooled air was used in ventilating that part of the mine. The cooling and subsequent contraction of the wall rock drives the rings of stress farther back into the virgin rock and relieves the stress close to the surface. Projecting corners are a potential source of danger as they may be thrown out with violence. Where other methods of support have proved inadequate to withstand very heavy pressure levels and drifts have been kept open by using steel rails put together in two sections to form an ellipse or circle. Round pole lagging is placed all around the outside of the sets. A layer of 1 to 3 ft. of sand or finely broken rock filling should surround the lagging, as any contact of the sets with the solid rock wall is practically certain to cause failure at that point because intensified local pressure distorts the ellipse or circle and collapse follows.

Where stopes with pillars between are used the trend is to use narrower stopes rather than to see how large a span can be kept open. In open stoping with pillars, the pressure on pillars is being studied by the U. S. Bureau of Mines and some mining companies. The velocity of sound in pillars was correlated with pressures

† Presented Annual Metal Mining Convention, Western Division, The American Mining Congress, Colorado Springs, Colo., September 16-19, 1940.

on pillars, i. e., the velocity of sound in a pillar would vary if the pressure on the pillar changed. In certain pillars very little pressure was indicated. Thus it would seem that the roof acted as an arch in compression, and the function of these pillars was largely to support the arch and keep it in line to take the compression.

Hydraulic filling of stopes offers excellent support, but disposing of the water drained from the filling may present quite a problem. By keeping about a foot of water above the top of the sand filling one company has found that the sand filling distributes itself with surprising uniformity over the entire stope, maintaining a level that is practically horizontal. Where the use of wet filling would be objectionable, as from the standpoint of pumping out the water or because the air in a hot mine would become saturated, there would seem to be a field for pneumating stowing, as is used abroad in coal mines. One metal mining company made a few trials of the method. In one experiment, 4-in. material was blown in at an effective range of 20 ft. by a stream of compressed air under from 65 to 80 lbs. per sq. in. pressure. Some 2,600 cu. ft. of air was consumed per cubic yard of filling.

Air Conditioning Mines

Several deep mines abroad either have installed or are installing air conditioning plants. Through their aid it will be possible to extend mining operations to a depth of 10,000 ft., or even more, a depth not attainable without cooling of the ventilating air. In this country artificial cooling of mine air is used at two mines with markedly beneficial results. In one instance, a drift 5 by 7½ ft. in section and 1,800 ft. long was driven in rock having a temperature of 112.5° F. Cooled air, at a velocity of 320 ft. per minute, was sent through the drift for a year and conditions were then as follows: Air entering the drift, 69.5° F. wet bulb and 91° F. dry bulb; air leaving the drift, 71° F. wet bulb and 95° F. dry bulb. At this same mine it is now possible to begin stoping soon after completing a level. Formerly, without cooling the air, stoping was not started until connections to the level above had been driven and the block of ore had been allowed to cool for four years. Refrigerating machines are now more efficient though using only two-stage compression than when formerly using three-stage compression, and they operate at slightly higher speeds.

In mine ventilation, the axial flow or modified type of propeller fan is finding favor. Closer control is being paid to the quantity and quality of air being circulated in various parts of a mine. Unless the shafts were considered in planning the system of ventilation for a mine the shafts may later prove to be the bottleneck in the circulation of air. Mine resistance may be reduced by increasing the area of the outlet shafts where this is feasible.

Mining Methods

In regard to mining methods, where conditions are favorable, shrinkage stoping is followed but strong walls and firm ore are becoming less common. Weaker walls and the presence of waste in the ore are bringing cut-and-fill stoping more to the front. Inclined cut-and-fill stoping as formerly practiced in some mines is being modified to cut-and-fill stoping with a flatter inclination of floors, say about 35°, and scraping or even to horizontal cut-and-fill stoping and scraping because the ore is less hard and firm. It is more difficult to support a steeply dipping back, even with stulls at infrequent intervals, than if the back is more nearly horizontal or is flat.

In a combination of square setting and shrinkage stoping, square sets, two or three sets wide to reach from wall to wall of the vein, are carried up from one level to the level above leaving most of the broken ore in the stope. On completing the stope the broken ore is drawn off and fill for the entire stope is run in from the top.

In a modified form of shrinkage stoping, referred to as "powder blasting," in fairly large ore bodies the back is broken in a series of horizontal slices, the maximum thickness of which is limited to about two-thirds the width of the vein at that point. A series of drifts and powder pockets are driven over the top of the slice which is then blasted in its entirety at one shot.

An interesting variation of shrinkage stoping uses untimbered chutes in the footwall with no gates at the bottom. The chutes discharge into the end of short crosscuts from the main haulage level. The ore is handled by mechanical loaders. The flow of ore into the crosscut stops when the ore reaches its angle of repose on the floor of the crosscut. Eimco Finley machines have loaded as many as 36 15-cu. ft. cars in one hour.

An unusual method of support was followed at one mine where a capping of clay, quicksand and surface material some 50 ft. thick was excavated by a Diesel-electric dragline. Shrinkage stopes were driven up from the level below. The intervening pillars were shot and the exposed top of the broken ore was then leveled. Two layers of heavy wire fencing were laid on the ore and long round timbers were then placed on the fencing parallel to the stroke of the vein. As the ore was drawn on the level below the timber mat was built up until it was from 20 to 40 ft. thick depending on the width of the vein. Gravel was then dumped on the timbers for backfill as the ore was drawn down.

Conveyor Trends

Shaking conveyors are being tried in block caving to transport ore from finger raises to main raises from the haulage level. Methods of feeding ore from the fingers is being worked out, but the question of timbering to keep the conveyor drifts open under the heavy pressure brought on them is a serious problem. The use of an inner reinforcing set or part of a set is necessary. Possibly, steel sets or concrete might be used. It is reported that steel timbering is used in top slicing at a foreign mine. Concreting of slusher drifts is successfully followed at one mine. Three sets of conveyors in series have been considered for block caving. One set serves finger raises, and two of these conveyors, in the same straight line, discharge from opposite sides onto a cross conveyor running between them. Several cross conveyors serve one main conveyor which, in turn, discharges into one haulage raise for the entire block.

In block caving there is a trend toward "grizzly control" with only two fingers and a somewhat wider spacing of draw points instead of having "chute set control," with four fingers from each set and a grizzly in the raise below the chute set. Grizzly control simplifies development work as well as operation, but it does not give quite the sensitive regulation of drawing broken ore that chute sets do. It was interesting to see block caving in a limestone mine, where no timbering is used. The flat slope at the bottom of the two fingers serving one grizzly and the small opening from the fingers onto the grizzly, together with the coarse breaking of the limestone, made it unnecessary to use any artificial means of controlling the flow of ore. In one mine where scraping is practiced only single fingers are used along the slusher drifts. Steel I-beams are used as long caps over turnouts in several mines, where block caving is

followed. For such spans and loads very large wooden caps would be required.

Open Pit Mining

In open pit mining, large drills, as the Bucyrus Erie electric churn drill, with 9-in. bit, make holes 9½ to 10 in. in diameter. At some mines these holes are large enough to hold sufficient powder without springing the holes. Where holes are sprung, they usually fill up 3 ft. or so and should be drilled far enough below grade to allow for this and still break to the bottom of the benches.

Full-revolving electric shovels with Ward-Leonard control and caterpillar treads are ordinarily used. Dipper sizes of 2½ to 3 cu. yds. are more common on the iron ranges, and the 5-cu. yd. size is most common at the prophyry copper mines. In fast-digging ground such shovels may make as many as three complete cycles per minute for short periods. Where transport is by trucks the efficiency of operations is increased by having bulldozers scrape a smooth track for the trucks and gather scattered material for the shovel.

For blasting, black powder is giving way to some form of dynamite in order to secure finer fragmentation of the material and to prevent the forming of ridges or "camel backs" between holes. In dry holes 40 percent and 60 percent bag powder is used. Low freezing 40 percent gelatin dynamites, in sticks up to 8x18 in., weighing 50 lbs., give good results in hard or wet ground. Loading holes with this large stick powder is facilitated by having a windlass and a small rope. As much as 10,000 lbs. of dynamite a shift can be loaded in this way in holes up to 100 ft. deep by three men. Primacord fuse is used for firing the blasts.

In blasting where churn drill holes must be protected from caving by casing for several feet down from the surface, one company has found that for shooting a large number of holes at a time it is more economical to use a prepared paper casing than heavy iron casing.

Haulage and Power

Haulage in open pit mines is divided between trucks and locomotives. On the iron ranges 15-ton tucks will negotiate upgrades of 10 percent and return on down grades as steep as 20 percent. For stripping at copper mines, trucks as large as 22½ cu. yds. (45 tons) have found favor. In the differential or motorized-car system of haulage axleless cars have been introduced, the trucks opposite each other are entirely independent in operation. Diesel-electric locomotives, in 125-ton, 1,000-hp. units, have been tested under hot climatic conditions and have proved satisfactory. Tests show no reduction in draw bar pull up to an elevation of 8,000 ft. No tests have been made above this elevation. Mine track is given careful attention. At one mine the main line is laid with 130-lb. rails. Ties on the more permanent tracks are treated with a preservative to increase their life. At another mine steel H-beams, set in concrete, are used for posts and I-beams across the posts carry messenger wires from which the trolley wires for double track haulage is suspended.

At one mine, power for General Electric d. c. locomotives is supplied by two Westinghouse three-phase mercury arc rectifiers, which give a satisfactorily smooth wave-like current. Such rectifiers have the advantage that for about 600 volts or over they are more flexible, have a slightly higher efficiency, and have no rotating parts compared to rotary converters or motor generator sets. The open pit is divided into sections so failure of power in one section does not affect the other sections. Many repairs on ore or waste cars are comparatively minor ones, yet require that the cars be cut out of trains and taken to the car shop. By arranging tracks so trains from the pit can be switched to pass directly through the car shop lost time for making light repairs will be minimized.

Underground, more attention is being given to keeping track in good condition. A concrete-lined drainage ditch has been found to keep the roadbed dry in one mine and prevented the sinking of ties into softened sections. Water from the usual ditch along the track tends to seep into the roadbed. The use of a couple of inches of concrete under extra wide wooden ties increased the capacity of main-line haulage nearly 40 percent by doing away with derailments and other track troubles at one mine. In general heavier rails and also welded joints are more in evidence than before. Ventilation doors, as commonly placed, require an air cylinder of long stroke to open the doors 90 degrees. In one case, the stroke of cylinders has been greatly shortened by having the steel door in two halves that meet to form an angle of some 30 degrees with the usual closed door. A strip of rubber along the vertical edges that meet at the center of the track and a triangular sheet of metal at the top serve to keep the door air tight. At another mine, the usual wooden door stops against a frame that has the outer 8 inches hinged and held in place by a rope passing over a pulley and weighted with an old car wheel or two. If the locomotive hits the closed door the hinged frame lets the door swing through with little resultant damage.

Drilling and Blasting

Drilling and blasting still remain the common method of breaking rock. Detachable bits are being increasingly used, as is reconditioning bits by hot milling. By using smaller starters and only 1/16-in. change in gauge holes can be drilled more quickly and with less consumption of air than with larger bits, and yet can be bottomed sufficiently large to take standard sizes of dynamite cartridges. However, a stronger grade of powder may be required to insure breaking the ground. For electric blasting in drifts, tunnels and shafts the trend is toward the use of parallel circuits where ample power is available. The burn-cut is growing in favor. One mine where the ground is hard uses this type of round in driving all drifts and raises, and 45 percent semi-gelatin in 1¼x12-in. sticks saves time in loading holes. The burn-cut is the easiest to teach to green men, and is simple in theory. Practically, it is not so easy to make the holes parallel, and a varying burden on the holes gives rise to trouble from bootlegs and increased powder consumption. The burn-cut leads to the thought of using longer holes, made by diamond drills or jointed steel, in drifts and raises. Fewer rounds would be required for driving a given distance. However, this would intensify the problems of keeping holes parallel and of mucking the greater volume of rock broken so this new cycle would be effective. Several mines are at work on the problem of drilling rounds with diamond drills.

The use of diamond drill holes for blasting in stopes is increasing. At one mine using shrinkage stoping where stopes were about 140 feet long, flat holes were drilled from vertical slots 15 ft. wide cut in the back at each end of the stope. The holes were drilled half the length of the stope. In this way ore was broken over the full length of the stope without the men being exposed to the danger of having to go out into the middle of the stope under a rather weak back. As a variation of drilling rings of long holes from several sub-level drifts to break a vertical slice the full height and width of the stope, a single horizontal cut may be taken over the top

of the stope and vertical down holes may be drilled the full lift between levels in a single row across the width of the stope.

High speed diamond drills revolving up to 7,200 r.p.m. have in experiments drilled much faster than the conventional type of drill running at 500 to 1,200 r.p.m., but skin friction and vibration of rods become troublesome at the high speeds. A quick-coupling rubberized joint has been devised to absorb the vibration of rods. A diamond drill with hydraulic feed and "fluid clutch" makes it possible to reduce the speed of the bit to almost any desired figure without changing the r.p.m. of the main drive. No gears are used, and the drill can be mounted on a crossbar or tripod.

Bits for high speed drills have up to two or three hundred small diamonds or bortz, ranging from 60 to 80 per carat. The stones may be set by hand or may have the metal of the bit cast around them. The Koebelite bit has many small bortz stones sintered in a metal powder. Strips of the material are brazed onto the blank bit. Also crushed bortz are used in an impregnated bit for high speed drilling. A cone (reintrant) shaped bit for grinding out the entire hole has been successfully used where no core was desired. This bit drilled somewhat slower than the regular core bit, but its over all drilling rate per shift was faster because more time was spent in actual drilling.

Improvements in rock drills make for easier handling during drilling. Vibration and power feeds relieve the driller from cranking the drill by hand. The power feed is somewhat more definite in its action, especially where two drills are mounted on the same column. In some cases repairing worn cylinders by chromium plating and grinding has obviated the need for oversize pistons. Each type of drill is made in several weights, making it relatively easy to select the most suitable drill for a particular type of work. The chuck parts of stopers are kept free from sludge by exhaust air coming out around the tappet. Jackhammer drills, instead of being held by hand for flat holes can have most of the weight supported on an air-cylinder type of leg thus making the work of drilling far easier.

Use of Scrapers and Loaders

Shovelling by hand is being eliminated wherever it is feasible by using scrapers and mechanical loading machines. Loaders are used in driving drifts in ground where they must be protected against a weak back by heavy booms, which restrict headroom. The loader must pass its bucket between the booms when filling cars. The basic designs of loaders have changed but little. Such an improvement as replacing the four-cylinder air motors with five-cylinder motors gives greater horsepower, greater torque at low speeds, and the ability to operate successfully on air pressures as low as 50 lbs. per sq. in. Heat treating of gear trains, gear shafts and axles make for longer life and less cost for repairs. Small scrapers are being used in stopes only three or four sets long. Light air-driven hoists and scrapers can be used in place of wheelbarrows. Scrapers are now so designed that an open hoe type can be converted into a quarter, half, or full box type by adding the proper side plates and braces. The cutting edge is made of several manganese steel plates bolted to the frame so the plates at each end can be interchanged with inside plates when the end plates become worn. These scrapers can be used with either two or three drum hoists.

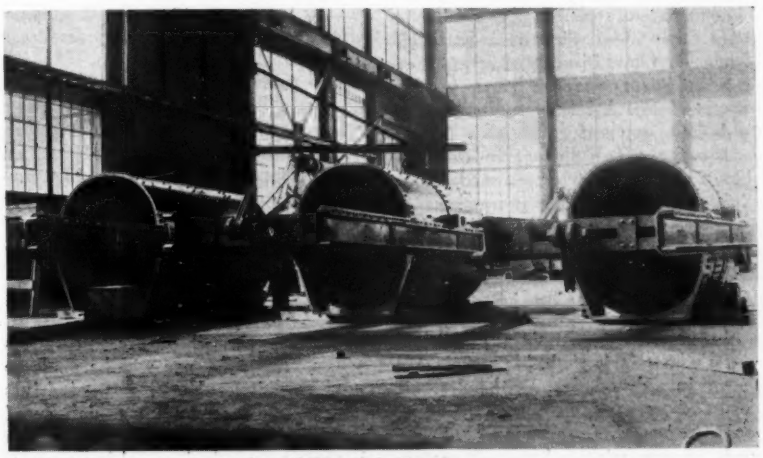
Shaft Sinking

In regard to shafts, in foreign countries the trend is to sink shafts 6,000 ft. deep rather than have two-stage hoisting for such a depth. The underground hoist has several disadvantages. An unusual arrangement of shifts for shaft sinking has been followed at one of the Rand mines. In the six compartment shaft, measuring 13½x37½ ft., four crews are used on a continuous cycle of 8-hour shifts. The sinking crew has an interval of 24 hours between shifts. Sinking a new shaft by driving pilot raises from several levels is done where such procedure can be followed. In one case, by drilling a diamond drill hole down into the top of the raise from the level above and blowing in compressed air immediately after blasting the time of waiting for the smoke to clear was reduced from two hours to only 30 minutes.

At the Silver King Coalition mine the new three-compartment Thaynes shaft was sunk to a depth of 1,745 ft. by using a pan in the center compartment and a cage and car in the outer compartment. The pan, when filled, was raised by an air hoist and dumped into a car on the cage. Since this shaft is to be used as a base for driving several levels the surface plant was designed to handle a large amount of waste. Skips dump into a reinforced concrete bin. A roll type feeder delivers the rock to a main conveyor inclined at 18° above the horizontal. This conveyor delivers rock to a shuttle conveyor which, in turn, delivers the rock to a stacker belt. The stacker belt builds up the dump on a 10 percent slope to allow for the eventual settling of the rock. The shuttle and stacker conveyors can be advanced as necessary to ultimately take up the full extension of the shuttle conveyor.

Radio Communication from Hoists

Several mining companies are installing large hoists which have two bicylindroconical drums arranged in tandem. Such an arrangement, instead of the side by side arrangement, permits placing the hoist close enough to the drum to avoid the need for intermediate idler towers. Wear on the ropes is reduced because the rope winds on the drum in a single layer only. One company is installing a special man elevator in the headframe to avoid the time and effort required to climb the stairs of the high head-



Oval nickel alloy skips

frame to inspect the rope and grease the sheave wheel bearings. Radio signaling makes it possible to send horn calls or even verbal directions from a moving cage to the hoist engineer.

Light alloy cages in which an alloy-steel frame is covered with aluminum alloy sheets are now commonly found at mines. An oval skip of nickel alloy steel has proved satisfactory.

Wood Preserving

Where timber is to remain some years underground it is in many cases given a preservative treatment to prolong its life. The "Osmose" process of treatment for green timber is being used at both coal and metal mines. By covering the timber with a paste of preservatives and allowing the treated timbers to remain in covered piles for some time as deep penetration of the preservative is obtained as with the pressure processes.

Wire Rope

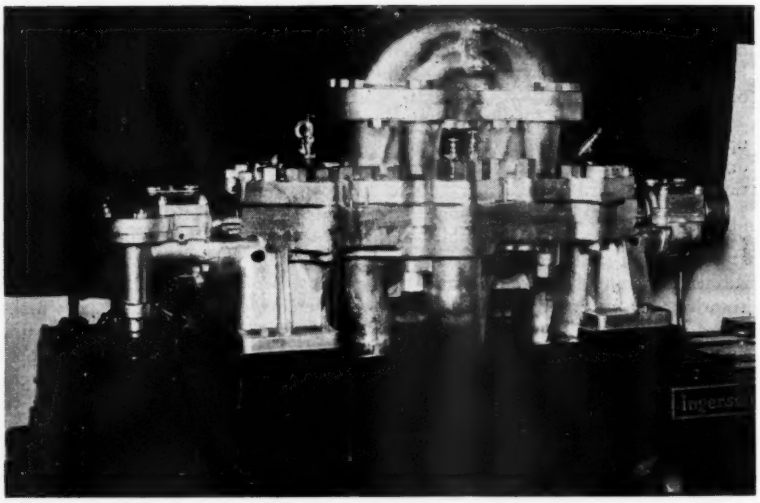
The type of wire rope to use for a certain kind of work is being more carefully considered. Where sheaves or drums of small radius are used as in scraping or on power shovels preformed rope seems to be favored. The rope is easier to put in place and broken wires do not project sharply from the rope. Tail ropes on scrapers are subjected to hard usage. In some instances, the use of a wire core for the rope and sheaves of larger radius resulted in markedly lengthening the life of the rope. Rubber-sheave treads give promise of being developed into workable form.

Lighting

Electric lights are now in use at many metal mines, and are standard equipment at coal mines. The lamps may have an alkaline or a lead acid battery. One objection that has been raised against electric lamps is that the headpiece has been so heavy that it became uncomfortable to carry on a hat for a full shift. In the new lamps headpieces have been made much lighter and lamps give as much as 20 percent more light than the older models.

Advances in Pumping Mine Water

In regard to pumping, conditions arise where it is desirable to place a pump in a drill hole. Drill holes cost less and can be sunk more quickly compared to shafts or winzes. Deep-well pumps with submerged motors



Six-stage centrifugal pump

are now obtainable in capacities up to 10,000 g.p.m. and for heads up to 800 ft. At one mine, shaft sinking was slowed down by the inflow of water. A bore-hole was drilled to take a casing of 19¼-in. inner diameter, and a submersible pump of 5,000 g.p.m. capacity against a 500-ft. head was put in. The pump consisted of two four-stage units, each with a 400-hp., 2,200-volt motor. One unit was placed at the bottom of the well and the other 250 ft. above, so the two worked in series. The pump drained the water zone so sinking was expedited.

For high lifts, both plunger and centrifugal pumps now have efficiencies of 80 percent and above. To handle 600 g.p.m. against a lift of 3,150 ft. two reciprocating pumps were placed in one mine. The pumps operated alternately. The temperature of the water was around 100° F., so an elevated sump was built to deliver water to the pump under a positive pressure. Pressure in the discharge line is 3,350 lbs. per sq. in. At another mine to handle 2,000 g.p.m. against a lift of 2,900 ft. a six-stage centrifugal pump is being installed. This pump will run at 3,550 r.p.m. At this mine water for drinking purposes is cooled in "day and night" type water coolers mounted on a stand, and supplied with a 1/3-hp. condensing unit.

Gold Dredging

Since we are still on the gold standard, a brief reference will be made to gold dredging. Variable speed drives make it possible to use a high speed for digging loose overburden, which is commonly valueless and hence overloading of gold saving equipment is of no moment. The slower speed is used for digging the gold-bearing gravel. Other improvements include electrical welding of steel parts, mechanical rocklifters in dumphoppers, high-grade alloy steel for shafting, rubber for riffles and a ridged stacker belt to keep material from rolling back. In Alaska banks of gravel around dredges are artificially frozen so they will not slide in on the dredges.

Some idea of the capacity of modern dredges will be had from the following table, which is based on an operating schedule of 22½ hours per day.

Size of Dredge Buckets	Cubic Yards Per Day
3	1,800 to 3,000
4	2,400 to 3,600
6	4,000 to 6,000
7½	5,000 to 7,500
9	6,000 to 9,000
12	8,000 to 11,000
15	10,000 to 13,000
18	12,000 to 15,000

The lower yardage applies to hard ground and the larger yardage to ground easy to dredge.

Tunnel Driving

In driving a long drift or tunnel that is not wide enough to use a portable switch to supply empty cars to the loading machine, a "cherry picker" with a vertical lift can be used to raise the empty cars above the loaded cars, as is done at the Carlton tunnel, in which a record rate of driving has been achieved, or a portable belt conveyor can be used. This extends over the top of the cars and is long enough

to load all cars required for cleaning out the round. In the Carlton tunnel, the jumbo carries five drifters on the front end. A similar drifter at the rear serves to drill holes in the roof to provide supports for the cherry picker. This type of jumbo is adaptable to the work of driving long drifts. Mounted on swivel trucks, it will pass over curves of 25-ft. radius.

Coordination of Industrial Dust Research

In conclusion, research on industrial dusts is being coordinated. In mining, silica is considered the most dangerous dust, but the effect of the dust of other minerals is not fully known. A complete investigation of dust would include a qualitative and quantitative examination of rocks that are a source of the dust in question, a physical examination of the size and number of particles in the dust, experiments as to its solubility, analysis by microchemical methods and the usual methods as well, and biological experiments to learn its effects on the lungs of animals.

— Discussion —

Recent Developments in TRUCK HAULAGE in the Lake Superior Mining District

By J. WILBUR VAN EVERA
Crosby, Minn.

RECENT developments in truck haulage in the Lake Superior Mines would be a history of the use of trucks in the iron mines of the district, since this use of trucks to haul ore from the open pit mines started a bare four years ago. I will confine myself to the very recent trend in types of equipment and the developments in their use and application.

Power Developments

Developments of the past year or two are entirely toward Diesel or Hesselman power on haulage units wherever the job is large enough to stand the cost of installation. Gasoline powered trucks will still be used on scram jobs and such developments where the first cost of equipment must be written off against a small annual production and a small total production. But even in this field small units powered with about 100-hp. Diesels are available at a relatively low cost.

Use of Superchargers

The first units of larger equipment (over 12 tons capacity) that used superchargers were first put in service on the Cuyuna Range last year. This year a very large number of the new units put in service have been equipped with superchargers, and some of the first of the larger trucks put in service are being equipped with them. Exhaustive tests by one operator comparing trucks without superchargers, with trucks of the same type and age equipped with superchargers, prove that on heavy grades the speed of the unit so equipped is increased between 35 percent and 40 percent. The over-all efficiency of the unit is somewhat less but significantly improved.

Fluid Couplings

The fluid coupling was also introduced in the power plant of ore hauling trucks for the first time last year. Early truck haulage in the mines was on comparatively easy grades and at slow speeds to a gathering point usually in the pit. With the extension of truck haulage to the job of elevating the ore out of the pit and doing the work of a hoist, an elevating conveyor or a railroad train in some cases, speed on heavy grades became important. To protect the transmission and axles from a tremendous strain when speed is changed through shifting gears with a load of 30 tons or more, the fluid coupling seems to have proven its worth. With this device in the driving assembly it is possible to start the load with the truck in the running gear it will use in elevating the load up the grade. By far the most of the new units put in commission this year are equipped with fluid couplings.

Increased Speed

Probably 90 percent of the tonnage moved by truck this year will be transported in units of 9 to 11 cu. yd. capacity bodies and 14 to 18 tons pay load. These units practically all have mechanical end dump open end bodies. The average speed on operation is greater than last year. More ore is being transported directly to the treatment plant or to railroad cars. The average elevation by trucks is probably increasing.

Body Construction and Load Capacity

There is no definite decision on the point of whether the load should be carried entirely on the tires or whether springs should be used to take part of the load. The advocates of the springless body contend that a longer tire life is obtained by not using springs. It is thought that this results from less swaying of the load than when springs are used. Most of the new units used this year however have springs under the body. Further time and further trial will probably result in some definite conclusion on this point.

New units being tried in our mines for the first time this season include a Diesel-powered Koehring Dumptor with a 6-cu. yd. capacity body and a 7-long ton pay load capacity, and a Diesel-powered Euclid with 16 cu. yd. trailer body and 32-long ton pay load capacity.

The Dumptor trends toward smaller load capacity, faster movement and simplified dumping mechanism. Its lower first cost makes it a competitor

of the smaller gasoline driven trucks. Its application will be in smaller scram operations and shorter haul jobs. I may say that the operators using this unit are satisfied that it is well suited to their particular job.

The large Euclid trailer type body with hopper dump trends to heavier loads and slower movement. It takes the truck into closer competition with cars and locomotives on rails. It requires a larger initial investment per cu. yd. of hauling capacity, not only in the truck itself, but in the pockets necessary to handle the load from a hopper. On a proper sized job and under conditions suited to its use, it must show a lower labor cost. So far this season it has not been used under conditions which seem best suited to it but the operators seem to feel that it will be a satisfactory unit. This unit is equipped with superchargers and fluid coupling. It has a very short turning radius (27 ft.), and it seems to be doing well the work it was designed for.

Roadway Construction and Maintenance

There is a distinct trend toward building and maintaining roadways for the trucks. The tire cost will amount to about 10 percent of the cost of truck operation, and repairs and maintenance will account for another 20 percent of the cost. These two items are directly affected by the quality of roads, as are the speed and size of load particularly on grades.

At one mine where several million tons will be hauled up an 8 percent grade, 3,500 ft. of 30 ft. wide 8 in. thick stabilized gravel surface has been built. This roadway has been satisfactory for two seasons and is now to be topped with 1 in. of heavy gravel and oil surface.

At another newly developed mine on the Mesaba Range where probably less than a million tons of ore will be shipped, 1,200 ft. of 7 percent grade has been paved with concrete; this in the form of two 3 ft. wide ribbons 7 in. thick. One operator is building his roads of ½ to ¾-in. jig tailings mixed with clay. This is of course something like a stabilized gravel top. In all cases, it is necessary to have a well drained base and where a road out of a pit is in clay it is customary to dig out a few feet of clay and replace with lean ore, rock or coarse gravel.

The roads are maintained by use of the usual road surfacing machines and for keeping the area around the shovel in shape and for maintaining the dumps a bulldozer is indispensable.

At one mine where locomotive haulage is still in use it has been found advisable to grade truck roads down into the mine. This operator thinks that there is enough saving in making shovel repairs in the pit and in permitting the foreman to get quickly to the operation in his car has more than paid for the building of the road. It is questionable whether this road would have been built if the operator had not had road grading equipment which he used for the maintenance of the truck roads at a neighboring job.

Performance Records

Most of the users of trucks started in to keep accurate and detailed data on the performance of the various units. Thus comparisons are available not only with other types of haulage but between the various types of truck units. There is now available considerable data to guide an engineer in selecting the best type of truck for a particular job.

In mines of moderate shipping capacity; that is, mines that will ship up to 400,000 tons a season, the use of trucks has reduced the haulage cost to roughly one-half of what it formerly was when locomotives and cars on rails were used.

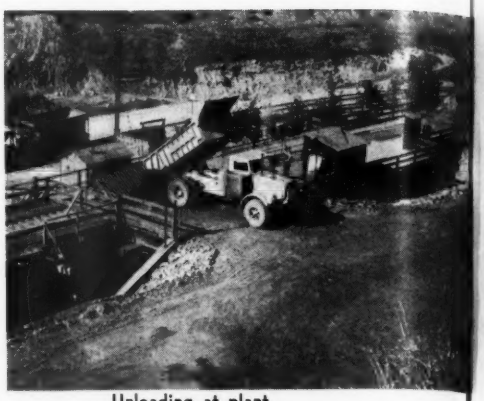
In smaller scram operations the saving is greater. In at least two cases ore bodies that would have been mined underground were operated as open pits.

Truck Haulage at Open Pits

In many deep narrow ore bodies considerable ore that would have been tied up in railroad truck benches and mined by scram methods has been released for open pit mining by introducing truck haulage.

In mines where the grading of ore to chemical analysis is a problem as it is on the Cuyuna Range, truck haulage has greatly simplified this and has made for a closer grading of cargoes.

The application of trucks to open pit mining in the Lake Superior District has its limitations of course. One would have to be a very partisan enthusiast to envision trucks as replacing rail haulage at the Hill Annex Mine where upwards of three million tons of material have been moved this season with economical electric locomotive haulage at a cost of less than 1 cent per ton mile, or at the Hull Rust where more than 10 million tons will be hauled this year with steam and Diesel locomotives. The use of trucks here must be incidental to rail haulage and merely supplement it in more inaccessible parts of the ore body.



Unloading at plant

But there will be moved by truck from the mines of Minnesota this year more than 10 million tons of material, which is quite a record when one considers that the first time truck haulage was used to any extent was only four years ago.

Cost Records

The records of one operator who moved in the years 1936, 1937, 1938 and 1939 a total of 3,691,000 cu. yds. of ore and waste are of particular interest. They show an operating cost of $0.0476 and a total cost including overhead and depreciation, taxes and insurance of $0.0852 per cu. yd. of material moved.

The operating cost per truck hour was $2.21 and the total cost per truck hour was $3.757.

As indicating the improvement in the operations, the costs on 2,096,000 cu. yds. moved in 1939 were: Operating cost $0.035 and total cost $0.0733 per cu. yd. of material moved and $1.70 operating and $3.60 total cost per truck hour.

In the above, costs depreciation was figured on a 10,000-hour life of truck, tires on a 3,000-hour life, interest at 6 percent and taxes and insurance at 12 percent of the labor cost.

In costs given, interest, depreciation, taxes and insurance account for about 38 percent of the total; tires for 9.5 percent; repairs including labor and material, 17.5 percent, and supplies, fuel, service labor and operating labor, 35 percent of the total cost.

At one property, hauling under heavy adverse grades, the rail haulage costs in 1937 were $0.1583 per ton. These were reduced in 1940 to $0.0829 per ton. The years 1937 and 1940 are compared because the operating conditions and tonnage moved were more nearly alike than other years.

DIAMOND DRILLING and CONVEYORS at Consolidated Coppermines Corp.

By PAUL J. SIRKEGIAN

General Superintendent
Consolidated Coppermines Corporation

DURING the past 16 or 17 years at our property we have done a great amount of diamond drilling in the sedimentary flanks of the main porphyry ore intrusion. Along the sedimentary flanks we have to date picked up occasional bodies of higher grade copper ores. Most of the drilling, however, which developed the larger tonnages of the corporation's disseminated copper ores in the porphyry rock has been accomplished by the use of churn drills. We used the old Star and Keystone steam-powered churn drills until a couple of years ago, at which time we purchased a more modern cable tool rig mounted on caterpillar tractors and powered with an independent diesel power unit.

We have attempted several times to drill in the areas of our so-called disseminated porphyry ore deposits, but we have never been able to get any satisfactory results owing to the shattered and crumbly condition of the ground which has been impossible to core successfully.

Just recently, after several discussions of our particular problem with the manufacturers who are developing a light weight, high-speed diamond drill, we agreed to try the drilling of a series of shallow holes up to around 200 ft. in depth. These holes are proposed to be drilled in the sparsely churn drilled fringe areas of our presently developed ore bodies, mainly for the purpose of more closely determining the ore body bottom contact, and in some instances, the thickness and grade of the ores. The manufacturer feels that the higher drilling speeds of this drill, which range several times greater than that of conventional diamond drilling, might lead the way to successful coring and drilling this type of ground. Recent development in bit construction is also expected to aid in this trial drilling. I am informed that drilling started a few days ago and, naturally, we have not yet had time to see how successful the drilling is going to be.

In regard to conveyors, we have several of the shaker type conveyors at our property now which we have been trying for several months. As a matter of fact, we have been trying them since January of this year. We do a large amount of slusher mining at our property in conjunction with block caving of the lower grade copper ores disseminated in porphyry.

The areas in which we use scrapers are usually high lying ore bodies in respect to our main haulageways that are quite thin and low in grade. Therefore, the preparatory work must be kept at a minimum in order to economically mine such ores.

We think, when conditions are suitable, a shaker type conveyor will, in all probability, transport ore or waste cheaper than by slusher hoists and scrapers. Our experiences to date have indicated that the Emma Nevada mine is one place where it is not practicable nor economical to use conveyors because of the certain existing physical conditions.

It may be well to point out that because of the undulating bottom contours of our Emma Nevada ore body and its varying thickness and grade, which in several sections of the mine is relatively thin, of low grade and high above our main haulageways, it is necessary to extract the ore with the minimum amount of preparatory work. This fact was the prime reason for the development of slusher mining at our property.

In the thinner and high lying ore areas of the Emma Nevada mine where the slusher mining method was being used, it was felt that any practical mechanical means of transporting ore horizontally might tend to cut down the overall costs of mining. This reasoning led us to the decision of trying shaker conveyors. We had learned from experience in this mine that the ground at the ore body bottom contact was generally heavy and difficult to hold due to the shattered condition of the ore body and footwall in close proximity to the contact and, therefore, the problem of repair and maintenance of the preparatory mining openings was always a serious one. We also have experienced occasional heavy runs of wet, sticky and, sometimes, "soupy" ore in nearly all portions of this mine which is impossible to transport with conveyors but can be handled by slushers. We, therefore, are convinced by these two existing factors that we are not going to be able to successfully use a shaker conveyor or any other type of conveyor.

The conveyor, which is quite a bulky and complicated piece of equipment as compared to a rugged slusher hoist and scraper, is indeed a cumbersome unit to get out of the way when the ground starts to squeeze and heave and displace the sides, roof, and bottom of the drift out of alignment. This action of the ground is generally expected in most areas of the mine and it is common practice with us to continue operating a slusher hoist while the repair work is going on. Oftentimes we are forced to use a narrow scraper while repair work is going on, but, nevertheless, the work can continue in the quickest possible time. A conveyor installed under such conditions when heaving and displacement takes place is in considerable distress and must be removed immediately which is quite a chore in itself.

We are convinced, by our experiences to date, that as long as conditions are ideal a conveyor will handle the ore more rapidly than a slusher in the same drift cross section, but this rapid transportation of ore is not necessary in our particular standard slushing drifts driven at or near the ore body contact because a slusher hoist and scraper, as practice has shown, can easily handle the ore as fast as it caves. One of the axioms demonstrated by our operations is that ore be drawn only as fast as it caves, and any attempt to increase or retard the natural caving leads to many costly troubles, such as:

(1) Rapid caving causes chimneys to be formed in the ore, resulting in undue dilution with overlying waste and poor extraction.

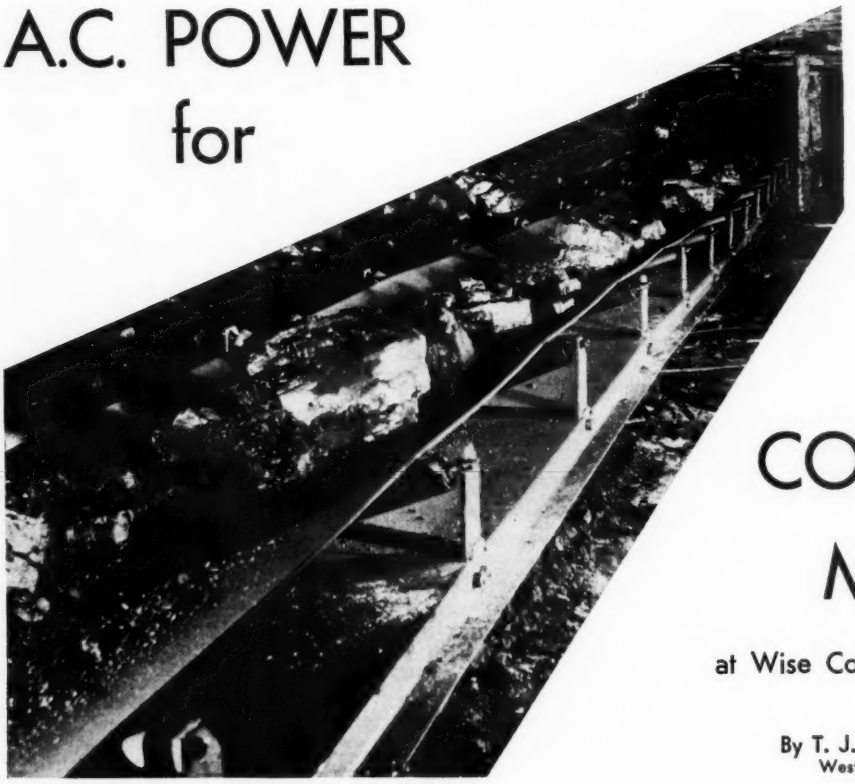
(2) Rapid caving causes voids to be formed which may suddenly collapse and cause devastating air blasts, dangerous to men and equipment.

(3) Slow or delayed drawing will invariably subject the preparatory mining openings to undue weights and quickly cause them to collapse.

We tried installations of conveyors in areas where we thought minimum amounts of wet muck would be encountered and where installation would be in drifts at considerable distances below the ore body bottom contacts where better ground conditions might be expected. One particular installation was at a horizon considerably be-

(*Continued on page 59*)

A.C. POWER for CONVEYOR MINING



at Wise Coal and Coke Company

By T. J. JACKSON
West Virginia Engineering Co.

DEVELOPMENT of the No. 2 mine in the Norton seam of Wise County, Virginia, by Wise Coal and Coke Company, was begun in the early part of 1939. A haulage way for the mine was established by tunnelling from the main entry of an existing mine in the Dorchester seam, the cover interval being approximately 90 ft. The distance from the mouth of the tunnel to the common tipple for both mines is approximately 3,000 ft.

It was highly desirable to employ the same haulage equipment and rolling stock for both mines. The 50-in. Dorchester seam height, and the 36-in. Norton seam height dictated that this could be accomplished only in sections where a sizable amount of rock was removed in the Norton seam. It was decided to take top only on the main entry, driving it at a height of 6 ft. for a projected length of 2 miles.

Mining Plan

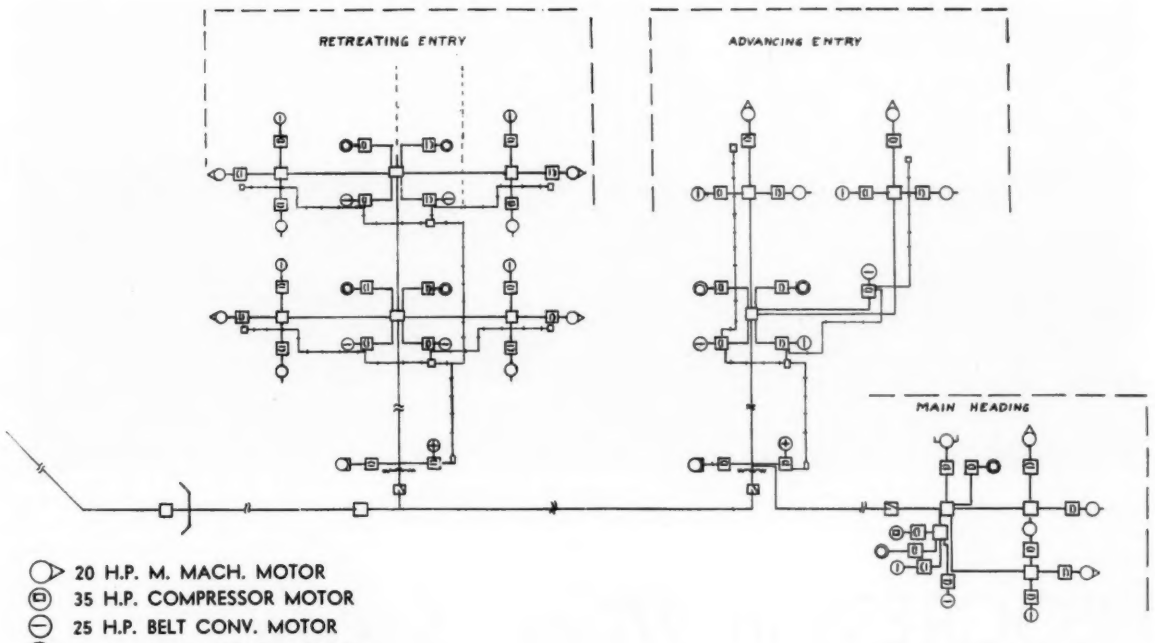
Due to these conditions, and the trend in mining, a belt and chain conveyor system of mining was selected. The cross entries, or belt entries, are now being driven to the left of the main entry at 620-ft. intervals, with a maximum length of 2,000 ft. Two belts are used with arrangements for driving one cross entry with two room conveyor chain units and for retreating one cross entry with six room and and face conveyor chain units (only four are used under present schedule of production). Rooms are driven 75 ft. wide for a length of 300 ft., on each side of the belt entry, top conditions being very satisfactory. The main heading and air course are being developed with a duck-bill shaker conveyor unit and a room and face chain conveyor unit. Under this plan all work is highly concentrated, enjoying the many advantages which this offers.

The mine power for the Dorchester seam mine was 550 volts direct current. Due to conditions already outlined, this power system has been continued for haulage power on the main entry of the No. 2 mine.

A.C. Equipment Chosen

The selection of the type of electrical equipment and operating voltage for all other drives in this mine was carefully considered from all angles—feasibility, safety, continuity of power supply, regularity of speed of equipment; investment requirements for motors, control, wiring, transformers, feeders, and converting units; and maintenance of equipment. On this basis, it was decided to employ alternating current, three-phase, 440-volt induction motors.

The wiring and control for the electrical system was given the same care used in selecting the type of motors. The single line diagram pictured below shows the layout which has been used. Power is supplied for this equipment through an airway driven to the outcrop slightly above water level at a point some 1,200 ft. distant from the mouth of the main entry, over a 3-conductor, 5,000-volt non-metallic sheathed cable with copper shielding tapes on conductor insulation and grounding wires in the interstices of the cable. Two banks of 3-37.5 k.v.a., 2200/440-volt transformers are employed on the main entry for transforming power. Both banks of transformers are mounted on portable trucks which are shunted to break-throughs between the main entry and air course. One is located opposite the retreating cross entry to supply 440-volt power for this entry; one is located opposite the advancing entry to supply power to this entry and the heading equipment. Each transformer bank is equipped with a 2,200-volt oil switch having over-



load relays. The transformer banks are moved only when a cross entry has been completely retreated.

All 440-volt cables are 4-conductor, flexible, having non-abrasive rubber sheath. Cross entry cable lengths are 250 ft., the ends being equipped with factory vulcanized junctions. Conductors of all cables are identified, the fourth conductor being used for a grounding wire. Plug and socket junction boxes are provided for the cross entry cable at the mouth of all rooms, the plugs being factory vulcanized. Room cable lengths are 300 ft., each room being provided with a plug and socket junction box at the room end of the cable. The feeder cable for all motors and machines have factory vulcanized plugs.

Each motor is controlled through a three-pole magnetic contactor having thermal sustained overload protection. Each motor is equipped with ball bearings, the standard service motors being used.

Remote control of the equipment is accomplished on the belt entries from the loading point through a single conductor control cable and in the room with a two-conductor control cable. Room cables and room control cables are stored on reels.

Through the fourth conductor of all cables in the system the frame of every motor and its control equipment is rigidly grounded. A system ground has been established at the entrance of the fan-way, having a ground contact resistance of 8 ohms. There are no exposed live conductors or parts in the system and no friction tape is used, except at motor junction boxes.

500 Hp. Connected Load

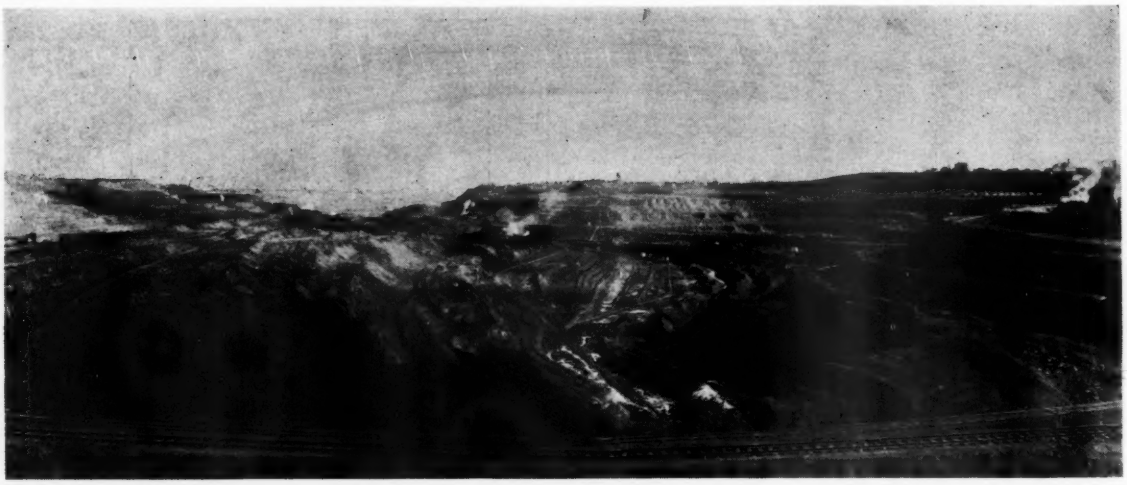
There are in the system at present 46 alternating current motors with a rated connected load of 422 hp.; the ultimate plan requiring 56 motors with a connected load of 500 hp. The average 15-minute power demand for this equipment is approximately 140 kw. This is evidence that the application of this mining load has been so regulated that there are 3 hp. connected load in motors per kw. of 15-minute demand.

The kilowatt hours used per ton of coal mined over the three-month period ended August 31, 1940, has been 2.4. This includes all energy used in cutting, drilling, ventilating rooms, conveying coal to the main entry and taking slate on the main entry.

No appreciable difficulties have been experienced with the operation of the electrical system of this layout during its life to date. There has been no time lost due to power outages and the speed of equipment does not vary perceptibly. One salaried electrician attends to all maintenance of equipment and is present whenever electrical equipment is moved. Some minor initial design difficulty was experienced with coal drills, which were equipped with 220-volt fuses and this has been eliminated.

There has been one failure of the 2,200-volt cable entering the mine on the airway due to negligence when loose top was being taken. The 2,200-volt cable on the main entry from its mouth is kept entirely safe and free from injury by placing it in a trench 12 in. deep, cut at the bottom of the coal along the right rib of the entry with a machine mounted on the side track.

In general the electrical system for this layout is measuring up to expectations and reflecting the care and attention to details of electrical design which have been taken and which generally have been long neglected in mechanical mining. Mr. H. W. Renfro, superintendent, and Mr. J. B. Taggart of Wise Coal and Coke Company, have supervised the development and operation of the plant with the West Virginia Engineering Company as electrical engineers and advisors.



An open pit iron ore mine in Minnesota

PROGRESS in *Mine Safety*†

By
G. J. BARRETT and D. F. DONOVAN
Oliver Iron Mining Company

WITH full recognition of the important work of other companies who pioneered in the safety movement perhaps as early or before the corporations we are connected with, we will, for the sake of accuracy use illustrations of safety progress with which we are familiar as a matter of record.

Tribute might be paid to the first safety campaigns of the H. C. Frick Coke Company in 1890 where the personnel of the mines of that company were advised in writing that:

"We should always keep the fact prominently in our minds that it is the desire of our company and our duty as well, that we make the safety of the lives of our employes our first and most important business."

As early as 1905 the slogan, "Safety First" was posted on the bulletin boards at the Chicago and Joliet plants of the Illinois Steel Company. A year later the safety movement was launched with zest and zeal by organizing accident prevention in all outstanding industries carried on in the United States. In 1906 meetings were held where the problem of reducing accidents was made a major one for the consideration of those leading in the mining of ore and the manufacturing of steel.

In 1908 the late Elbert H. Gary added the force of his genius, ability, and personality to the progress of safety. Speaking to those most concerned with the welfare of the corporations he represented, he said:

"We should like to take a prominent part, a leading part, in any movement and in every movement that is calculated to protect employes of the different corporations in which we are interested, and any requisition which is made for the expenditure of money to install equipment to protect our people will be honored."

In the light of the foregoing, safety has more than kept up with the times. Mining in the Lake Superior District is gigantic and varied, made up of underground mines of immense depth and open pit mines of enormous magnitude, where is produced and from which is shipped approximately 85 percent of the iron ore consumed in the United States. Its safety mindedness is just as broad and far-reaching as the great scope of its operations above and below ground.

Mining may no longer be considered the most hazardous of our major industries, and this is particularly true of the iron mining industry in the Lake Superior District. It has always preached and practiced the old adage "that an ounce of prevention is worth a pound of cure."

Lake Superior Mining Paces Safety Equipment Installations

At the outset we say without fear of contradiction that mining in the Lake Superior District has not only kept pace with the progress of the industry generally, but actually has led it in installing everything worthwhile and practicable to make more safe and less hazardous the work of its employes. We are familiar with the be-whiskered wise-crack that "figures don't lie, but liars do figure" but we are sure this gathering made up largely of engineers will take the word of the National Safety Council telling us that the all-industry frequency accident rate for 1938 in the United States was 12.2 per million man hours—or 26 percent higher than the iron mines of Minnesota. Facts establish that among all American in-

† Presented Annual Metal Mining Convention, Western Division, The American Mining Congress, Colorado Springs, Colo., September 16-19, 1940.

dustries, the iron ore mining in the Lake Superior District has become one of the safest.

Praises National Safety Council and Bureau of Mines

Much credit is due the National Safety Council and the United States Bureau of Mines for work commenced and carried on by them in the interest of safety in mining for which we are grateful, and upon which we have learned to rely. I am sure many mining men present recall, as boys, the familiar sight of the mine bureau car present on a convenient siding for the purpose of instruction in first aid and safety. From the Bureau of Mines we have obtained convincing facts and figures showing that from 1911 to 1940 there has been a consistent reduction in accidents in the iron ore mining industry. We will not tire you with statistics but will be pleased to furnish you with such information upon request.

Let us now consider the evolution of safety as preached and practiced in the mining of iron ore.

Health and Welfare of Workmen of Prime Importance

The physical well-being of the workman is of primary importance in its relationship to safety. The good health of the employe and his family is given impetus by the furnishing of competent medical doctors and excellent hospital facilities sponsored by the mining industry. The best of medical care and hospitalization is furnished for this as well as humane reasons. Physical examinations are not only informative to the employer, but are beneficial to the employe as well. This sort of care and attention, besides providing an accurate survey regarding physical fitness, is also furnished with an eye to safety and the avoiding of accidents. Nor are the physically unfit overlooked; everything possible and reasonable is done to place them in some sort of useful and rehabilitating employment.

Mental health and poise in its relation to safety is also of the greatest significance. As a practical matter, safety must be predicated from the very beginning on the peace of mind and health of the workman. Consistent with this thought, the industry has at all times earnestly sought to provide the workmen with clean, practical and attractive homes, thus eliminating family worries and permitting closer attention to his job and the safety of himself and his fellow employes. Time will not permit our reviewing such facilities furnished by the different operators in the district, but splendid examples illustrating this important feature are the housing conditions furnished employes by the Montreal Mining Company at Montreal, Wis.; Pickands Mather Company, Hibbing, Minn., and the Oliver Iron Mining Company at Fraser, Minn.

Vital indeed to safety consciousness is the thought constantly uppermost in the workman's mind—that is, the welfare of his family and the opportunity for education, that perhaps he was deprived of in other lands, or due to the lack of facilities where he was raised. Here the child of the workman is surrounded not only by books, but also by practical teaching in the American way of living and is taught principles of safety which, inculcated in the mind of the child, are taken home to the parents.

Modern Change Houses

What could be more conducive to thoughts of safety than the approach to the place of work through the means of practical and attractive change houses? Illustrative of a model change house in the Lake Superior District is that at the Eureka Mine operated by the Castile Mining Company at Ramsay, Mich. The old frame building, with row upon row of steam pipes, red with hematite and over-run by cockroaches, is now a thing of the past, and in its place we see a two-story building, of concrete and brick construction with separate rooms for street and "digging" clothes; 287 lockers that are used for clean clothes only, concrete floors, shower room, toilets and laundry, and a suspension structure with hooks operated by pulley that permits the individual's hanging of underground clothes for drying and aeration, with individual padlocks supplied to make ownership secure.

Safety Planning

Safety planning is essential, of course. The slogan, "Safety First," is but an outpost of accident prevention. The initial work in safety begins in some highly skilled engineering department and takes form in designs emanating from the drafting room. With well thought-out ideas reduced to blueprints, the safety expert then begins to visualize practical equipment that will augment the safety movement. The most practical equipment is sought and if a better type is produced outside the industry, it will be obtained and installed, thereby making more secure the physical well-being of the artisan employed in the mining industry. One of the first requirements, however, is that equipment manufactured outside the industry must conform to its standard safety codes, thus providing against the possibility of either man or machine failure and thereby promoting the safety of the employe.

An ore sorting yard. Here the cars loaded with different grades of ore are sorted to make boat cargoes meeting the furnace requirements

Improvements in Equipment

Equipment of employes engaged in mining has kept step with safety progress. The industry has not been slow to adopt ideas developed and proved worthwhile in other fields. The hard hat and goggles are examples of the adaptability of many such things to mining.

Ideas of new and improved equipment for use by miners had to be proved worthwhile before the workmen would use them. Miners prove as temperamental as prima donnas oftentimes when it comes to convincing them of the usefulness of such innovations. The hard hat, for instance, was perhaps first suggested by the type of bowler hats in vogue during the gay nineties. Underground miners were long familiar with the hazard of material dropping from the back and striking them on the head. Canvas and cotton were poor protection against such a risk. Individuals were found taking their old cast off derbys and covering the outside with pitch or similar material that would tend to become hard and add strength to the "tar-paper" top. This was long prior to the introduction of the tin hats in the first World War. In the early 1920's hard hats, made of reinforced, non-metallic material, were appearing here and there in the industry. In recommending their use, it was emphasized that they not only protected from impact, but that they were also non-conductors of electricity and acid resistant. If the brim of the hard hat was found to be in the way when the miner was carrying something on his shoulder he would be inclined to cast the hat aside for something he considered more convenient. Today, the miner is not only completely sold on the effectiveness of the hard hat idea, but it is compulsory that such hats be worn by all employes and visitors underground.

Safety goggles were no doubt suggested by those used in the early 1900's by automobile drivers, at a time that the windshield and the enclosed car were unthought of. They were first introduced in the steel industry in or about the year 1909. First designed for shops, foundries, furnaces and similar employment upon the surface, their adaptation to underground and open pit mines was readily seen and put into effect. One of the objections first made to their use underground was the "fogging problem." Workmen complained that fog on the glasses interfered with their vision. How could this problem be solved? Constructive thought was given the matter, the side screens were removed. This improved the ventilation and avoided the steaming of the glass. Atmospheric conditions permitting, many miners use the goggles almost entirely while they are underground. Nothing more convincing of the usefulness and practicability of goggles for workmen in mines exists than the many cracked and shattered glasses exhibited at the mines with information upon tags attached thereto, explaining how the goggles saved the sight and possibly the eye or perhaps the life of the employe wearing them at the time of the accident. Goggles have been a boon to the safety movement in mining.

Top slicing method of underground iron mining. An electrically operated scraper in foreground

Dust Control

Working conditions as a problem has been elementary in mining. Oxygen is essential to life, hence much thought has been given to adequate ventilation in underground mines. Many years gone is the day that the miner was heard to complain of inability to keep a candle lit in his place of work. Ventilation on main levels only, by natural draft and by exhaust from drills in working places, has been supplanted by ventilation plants at the mine shaft and by individual blowers in each working place. Most surface installations have heating plants for winter use. There has been striking improvement in working conditions and control of the dust hazard. Pneumoconiosis, once a most ominous term, is now, as far as the iron ore industry is concerned, only a mouth-filling word. A word, descriptive of all types of dust inhaled during normal life, together with its partner in crime—silicosis—is no longer a problem to the air-conditioned underground mines. Outstanding medical experts have admitted under oath, that the dust of iron ore actually counteracts any possible baneful effect of free silica in human lungs.

In low dust concentrations, face respirators are used. In higher raise concentrations, air-line respirators are used effectively and with comfort. A good ventilation program, like a good safety program, reflects comfort to the workman and increased efficiency to compensate for the expenditure.

Advent of Hard-toed Shoes

In recent years hard-toed shoes were introduced in iron ore mining. This has protected the employes from possible injury as the result of hard and heavy objects falling on their feet. Shoes with steel toe caps are supplied at cost and they are now used enthusiastically by all workmen in the industry.

Damaged goggles, broken hats and dented shoes that have saved miners from the results of accidents, are mounted on reinforced cards and sent about to district operations for the incredulous to view with the thought that "Seeing is believing."

Adequate Lighting Promotes Safety

Lighting the place of work in underground mines in an adequate manner promotes safety. Since the introduction of electric lighting into underground mines, the drifts and working places have been transformed from darkness to light, thereby improving to a large extent the working condition of the miners. The use of 100-watt floodlights at the working face permits thorough inspection by workman and supervisor. This is a contribution not only to safety but also to efficiency.

Progress in Haulage and Use of Explosives

Tramming in underground mines has progressed from the mule and buggy days to what we meet with today. Mule haulage with wooden cars on light rail was followed by electric haulage, using trolley and storage battery locomotives, steel cars with automatic couplings and 40-lb. and 60-lb. rail system with automatic block signals. The transferring of ore by means of hand tramming in wood cars on light rails after loading the ore by hand shoveling, has been replaced by electric tugger-scrapers. Obvious at once is that the old hazardous tramming operation is now almost foolproof against injury.

Explosives are essential in the production of ore. The nitroglycerine-filled hole has gone the way of the ox-cart; it, together with the hazard of black powder, which was so destructive of life and limb, has been eleminated by the scientific mining. The progress in the type and use of explosives has been remarkable. The use of a central fuse house has permitted excellent control of the fuse and detonators, eliminating the unsatisfactory method of hand crimping of caps to fuses. The use of cap and fuse containers has resulted in dry fuse in good condition. The improvements in fuse and cap manufacture have produced a uniform burning fuse and reliable cap detonation. The development of a uniform fuse lighter has eliminated the danger of the miner taking too much time to light the fuse. Care exercised in the use of explosives as we have outlined has resulted in the reduction of missed fire holes and their attendant dangers.

Ore transferring is a corollary of mining and in its development one notes the far-cry from the pick and shovel, the hand drill and the sledge hammer, the wheelbarrow and the metal tamper. Its evolution might be described in these words: Yesterday, a wheelbarrow; today, an electric train and shovel; yesterday, buckets and vehicles in skip roads of changing angles, with wooden rollers for the cable to rest upon and rules of safety violated by miners riding on the bail of the skip, going to and from the surface and getting fingers cut off in absent-minded moments when they forgot to let go the rope when arriving at the rollers; today, shafts as straight as a string and enclosed cages for men to ride upon in safety. The results have improved working conditions and eliminated the hand tramming accidents of crushed bodies and hands and sprained backs.

A view of the ore docks at Duluth

Improvements in Mining Practice

Mining practice has improved by leaps and bounds. The safest methods of ore extraction have been adopted. Sub-level caving, top slice saving and open stope mining are given preference. The more dangerous square set method has been replaced by a safer practice.

Open pit mining has marched along with the advancement of underground mining.

Dump practices, made up in the old days of "side plows," hauled by locomotives and operated by two men, have been replaced by the spreader of structural steel, with enclosed cab and power controls, thereby reducing wrecks, derailment and consequent injuries. Steam locomotives, of four and six driving wheels, weighing approximately 44 tons, are about as familiar as the high wheeled bicycle of 50 years ago and are being replaced by 125-ton diesels. With heavier tracks, better roadbeds and fewer derailments, safety progresses. Stripping cars of the narrow gauge days, which were dumped with poles, have been replaced by 30-yard steel, side-hinged, roller bearing, double air dump, light weight, alloy steel cars, pneumatically dumped and righted by gravity. The elimination of danger and injury is at once manifest here. Steel shelter houses, with conical tops, for use as refuge while blasting, have reduced accidents and injuries. Caterpillar - mounted shovels, electrically operated, have replaced the old railroad type steam shovel, thereby minimizing accidents and injuries. Machine tool drives have been changed from line shaft to countershafts and belts to gear and direct-connected, thus making less possible injuries to fingers and hands. Mine hoists have been changed, from steam to electric operation, from hand brakes to parallel motion gravity brakes, including introduction of overtravel, overspeed and loss of power safety devices. Man cages are now fully enclosed and provided with doors. Most of them have been counterweighted and hoisting accidents reduced. Steam pumps with their high maintenance and their humid and hot pumping stations have been supplanted by plunger and centrifugal motor-driven pumps, thereby improving working conditions.

Job Analysis, Training Programs, and Safety Planning

Job analysis has made easy the progress of safety through analysis of individual jobs and adaptability of the employe to the particular job under consideration. Safety has always demanded an analysis of the job and its attendant dangers, but today more than ever this analysis is receiving most critical attention.

Training programs in first aid and of new employes cannot help but aid safety. This is being done and has been done in the Lake Superior District for some time. All employes in the Lake Superior District have been trained under the able direction of the United States Bureau of Mines.

Safety planning needs no explanation but mention should here be made that there has been a marked improve-

ment in the planning of the mining operations with safety foremost in mind—in open pits to avoid the dangerous high banks and steep grades, and in underground to select the safest method of ore extraction and the orderly mining of ore pillars.

Importance of Leadership

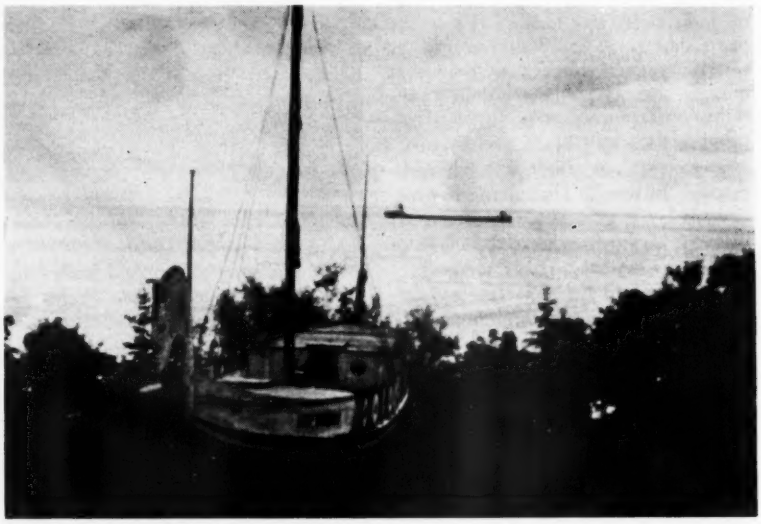
Mine leadership is of vast importance. Mining management has aggressively promoted safety by planning and organizing the personnel for safety. Mine captains, foremen and bosses are now more informed and selected according to higher standards.

The importance of leadership cannot be better emphasized than by quoting the late Charles M. Schwab's response to the tribute to American steel men made by Marshal Foch in 1921:

"Individuals and individual interest can accomplish but little; united effort and cooperation under single leadership can accomplish anything. So it is in industry, our industry, all industry, unity of action, unity of command, is the most effective means to great results.

"When a battle is to be fought, when a game is to be won, when a struggle of any kind is to be undertaken, we need first of all the great commander, the man with vision to see what should be done, the man with courage to undertake it, the man with power of leadership to induce other people to follow him. We of the great steel industry have much to learn from this great principle. The greatness of industrial achievement has been realized through the application of it, and America will continue to rise to still greater heights of achievement as she allows the principle to have freedom of action."

What is back of this humane thing in industry that we call "Safety First"? Back of the pit and the shaft, back of the drift and the crosscut, back of the raise and the stope, back of the drill and the hammer, back of the singing motors, back of the busy skip road, back of the whirring wheels is the THINKER. Who is the THINKER? The operator, engineer and workman whose combined thinking in terms of safety gives brawn and brains and heart and soul to a factor in industry that transcends production and profits —the safe return of the employe to his home and family as each shift ends in the mining of iron ore.



Giant ore boat of Pittsburgh Steamship Company approaching Duluth harbor. In the foreground is a half-size replica of the boat in which Leif Ericsson sailed to America in 997 A.D. conveying missionaries commissioned by the Norwegian king to Christianize the new continent. The replica seen in the picture was actually sailed from Bergen, Norway, following the same course along the north Atlantic pursued by Leif 943 years ago.

Use of Diesel Engines Underground Studied From Standpoint of Safety

Results of an investigation of the possible hazards involved in the use of Diesel engines in mines and tunnels in the United States, conducted by the U. S. Bureau of Mines, indicate that such engines should not be operated underground unless adequate ventilation is provided to guard against the danger from harmful gases discharged in the engine exhausts. The tests also demonstrated that the amount of such gases could be largely controlled by the proper adjustment of the ratio of fuel and air mixed in the cylinders. Such adjustments can be made without significant sacrifice of the power output of the engine. The Bureau's studies relating to this subject have been summarized in a paper by H. H. Schrenk, chief chemist, health division, and L. B. Berger, associate chemist.

The main phase of this study to date has dealt with the composition of the exhaust gas, knowledge of which is essential in the safe use of Diesel engines underground or in confined spaces. Such information may be valuable in establishing a basis for the ventilation of vehicular tunnels, as the requirements for Diesel engines may differ from those of gasoline engines.

The results of the study to date have shown that carbon monoxide, carbon dioxide, and oxides of nitrogen are present in exhaust gases in concentrations that are considered harmful to breathe. Under some conditions objectionable amounts of aldehyde and smoke may be produced.

The fuel-air ratio was found to have a marked effect on the production of carbon monoxide. It is significant that the production of carbon monoxide and smoke can be largely controlled by the proper adjustment of the fuel-air ratio without a significant sacrifice of power output of the engine at full throttle.

The experiments show that ventilation must be provided if the exhaust gases from Diesel engines are discharged in underground working places; that because of their toxicity, carbon dioxide, carbon monoxide, oxides of nitrogen, and oxides of sulfur (if the fuel contains sulfur) in the exhaust are the constituents of chief significance in relation to ventilation; and that Diesel engines in underground service should not be operated at fuel-air ratios on the rich side because under this condition the exhaust contains high concentrations of carbon monoxide and soot.

Ventilation required from Diesel engines underground has been considered by the Bureau of Mines, but additional factors that may affect performance of these engines must be investigated before comprehensive recommendations can be made.

A full crew of 325 men are operating at capacity the zinc plant at Kellogg, Idaho, of the Bunker Hill and Sullivan Mining and Concentrating Co. and the Hecla Mining Company.

Battelle concentration laboratory

LOSSES of COAL in PREPARATION

By BYRON M. BIRD
Chief Concentrating Engineer
Battelle Memorial Institute

STRANGELY enough the average coal company appears to have little regard for the essential commodity in which it trades, namely, coal. Even companies that have elaborate accounting systems in which every item of cost is figured down to the last mill commonly make no check on the recovery of coal in their preparation plants. Thus, while they are keeping close track of the mills they are letting cents per ton of output slip away from them.

Now I hope no one will sit back complacently and say "Coal losses do not apply to me, for I have such and such a coal cleaning process and it effects a perfect separation," or "My floats in the refuse are only 1 or 2 percent and how can I be losing any appreciable quantity of coal in the refuse?" That is the point of view of the proverbial ostrich, for any observing person must realize that inefficiency in washing is only one way of losing coal. Let any such person answer these questions. Do you recover and sell your sludge? Do you crush and rewash middlings? Are you cleaning some sizes at a lower washing gravity than necessary and thus wasting saleable coal? Are you cleaning only the coarse sizes and mixing dirty fine sizes of the raw coal with the prepared sizes? These are some of the many ways in which coal may be lost in a cleaning plant and as a matter of observation I would say that a high percentage of coal companies are losing coal in some one of these forms.

And by coal, I refer to saleable coal. Although we all agree that we should conserve our natural resources, we are also concerned with the making of a profit from the mining of coal and where losses are mentioned in this paper they refer to materials from which a profit can be made.

I shall begin with inefficiency in cleaning and treat it at much greater length than the balance of the losses. This does not mean, however, that it represents the most important source of loss. Probably in the average case it does not. The lengthy discussion has come about from the technical difficulties involved in this phase of the subject and from a desire on my part to treat the subject in a simple manner.

Losses Through Inefficiency of Cleaning

The Principle of "Exchange"

In order to discuss this point and one or two others that are to follow it is necessary to bring out clearly the

Presented at the Fourth West Virginia Coal Conference.

nature of coal cleaning. We can do this best by reference to a set of washability data such as given in Table 1. These data have been selected at random, but with minor changes in the weight percentages they might represent almost any coal. There are four columns of figures. The first (1) gives the weight percentages of the different specific-gravity fractions. The second (2) gives the ash contents of the different fractions. The third (3) gives the summation of the weight percentages, each figure showing the sum of all the percentages that have gone before. In this way it gives the result that is to be expected for a washing operation that is 100 percent efficient. The fourth (4) shows calculated ash percentages corresponding to each of the figures in the cumulative weight column.

What is done when this coal is washed?

The coal company arbitrarily decides on a basis of prospective markets, competitive coals, and the like that it wishes to wash its coal down to some certain ash content, say 4.1 percent ash. Upon referring to the data we find that this corresponds to a separation at 1.50 specific gravity as read in column 4. If a perfect separation is secured in washing, the coal will comprise the portion floating on 1.50 specific gravity or 90.0 percent of the feed as shown in column 3. Now let us note carefully what the coal company is attempting to do. Evidently the float-1.50 material is not all coal in the accepted sense of the word, for the product between 1.45 and 1.50 specific gravity, for example, analyses 22.0 percent ash and is very obviously composed of pieces of bone and otherwise objectionable materials, but it is significant that these apparently offgrade materials *belong* in the coal. If some of these "near-gravity materials" are discharged with the refuse in washing, they represent a loss of saleable fuel. On the other hand, if some materials between 1.50 and 1.55 specific gravity are recovered in the washed coal they represent a gain that in part compensates for the loss of saleable coal in the refuse.

Let us examine a set of data that might be obtained from washing this particular coal, as shown in Table 2. The feed contains the required percentage floating at 1.50 specific gravity and that portion has the required ash analysis of 4.1 percent. The washed coal is composed of some material floating and some material sinking at 1.50 specific gravity and the ash content of each component is given. Also the ash content of the washed coal as a whole is given; it analyzes 4.1 percent ash. Corresponding data are given for the refuse. Inasmuch as the washed coal has the same ash content as the portion floating at 1.50 specific gravity in the raw coal, the data represent a 1.50-specific-gravity separation even though there is some refuse material in the washed coal and some float material in the refuse.

When the washed coal contains some "sink" materials and the refuse some "float" materials and yet its ash content is at the washing gravity, it is evident that the percentage of sink in the washed coal together with its ash content and the percentage of float in the refuse together with its ash content are such that they just balance. This is an illustration of "exchange" in coal washing.

On first glance it might seem that with such an exchange there would be no loss, but column 2 shows that this is not the case. There a feed composed of 100 tons has been distributed over the various products. The raw coal contains 90.00 tons of recoverable material floating at 1.50 specific gravity, whereas the yield of washed coal is only 89.55 tons. The reason for the drop in yield of washed coal may also be found in column 2. There it is seen that material analyzing 33.96 percent ash has been included in the washed coal while material analyzing 16.04 percent ash has been rejected in the refuse. If the ash content of the washed coal is kept at 4.1 percent ash, it is evident that a loss in recovery must result from this interchange. The amount of this is 0.45 tons in 100 or since a yield of 90.00 tons is possible, on a percentage basis the loss is

$$\frac{0.45}{90.0}$$

or 0.50 percent.

To some people it is easier to look at this problem from the standpoint of efficiency; let us look at the figures. The 90.0 percent represents what it is possible to do; the 89.55 percent what was actually accomplished. Accordingly the true efficiency is

$$100\left(\frac{89.55}{90.0}\right)$$

or 99.5 percent. This figure gives us a percentage loss of coal directly, for the loss is 100.0 minus 99.5 or 0.5 percent. This is the same figure arrived at in the calculation given above.

Relationship of Washing Losses to Float-and-Sink Data

When one comes to the problem of analyzing any given washing operation he usually finds that if any data are being kept on the losses of coal they are in the form of float-and-sink tests of the refuse and it is evident from Table 2 that such data do not give the true washing loss, for column 2 shows 0.75 ton of float in the refuse whereas we have already shown that the true loss from 100 tons of raw coal is 0.45 ton. However, if percentages of floats in the refuse are based upon testing at the true washing gravity they can be used to arrive at a first approximation to the washing loss. This is done by using a factor that we at Battelle have obtained by averaging the results of a number of washing tests where both floats-and-sinks and true losses are known. Our figures show that approximately 60 percent of the loss in weight shown by the float-and-sink tests of the refuse is true loss in weight. Suppose, for example, that the reject constitutes 12 percent of the raw coal, or 12 tons in 100 tons of feed, and that the percentage of float at the true washing gravity is 15 percent. This means that the tonnage of float is 15 percent of 12 tons or 1.8 tons. If we apply our average factor of 60 percent the true loss is 60 percent of 1.8 tons or 1.08 tons in 100 tons of feed.

Methods of Arriving at Washing Losses

In any specific case the problem of arriving at the true washery loss is not difficult, but to outline methods that will apply to all cases is almost impossible. However, there are a few guiding principles that can be given from which most companies can work out a procedure satisfactory for their operation.

The following figures are needed: (1) The weight of the washed coal shipped, properly corrected to a dry basis or to some agreed upon moisture content, and the average ash content of the coal. (2) The weight of the feed to the washer and a correct set of float-and-sink data on the feed with the separation made at the true washing gravity. Suppose this is known to be approximately 1.50 specific gravity, the thing to do is to take a sample of the raw coal on a day that the railroad weights are to be checked. This sample should be separated at 1.45, 1.50, and 1.55 specific gravities, in other words at 0.05 above and below what is believed to be the washing

gravity. From these figures data similar to those in Table 1 can be prepared. From columns 3 and 4 short washability curves can be plotted and the weight percentage of the raw coal can be read off, that has an ash content corresponding to the ash content of the washed coal. These figures give the necessary data for arriving at the efficiency of washing and the washery loss can be obtained by subtracting the efficiency from 100.

The information as to the weight of recoverable coal in the feed and the actual weight of coal recovered in washing is fundamental in any determination of washery losses, but the method of arriving at the figures can vary greatly at different plants. For instance, several companies regularly weigh the refuse from the washing operation separate from the refuse from the picking tables. In this case a good plan, especially where there is much breakage in washing, is to prepare a composite sample of the washed coal and of the refuse and to run float-and-sink tests on each at three gravities near the washing gravity. The results can be combined in the proper proportions to give the true float-and-sink data of the feed. Once these are available the procedure for arriving at the washing loss is the same as if a separate feed sample is taken.

Another variation occurs where the weight of feed to the washer is not known. In this, a very common case, it is necessary to arrive at the yield of washed coal by calculation and this involves getting some additional data. The previous experimental work will have given the ash content of the washed coal and the ash content of the feed. In addition it will be necessary to determine the ash content of the composite refuse from the washer. These three ash contents, on a common basis as to moisture, can be used to calculate the yield of washed coal from the formula

$$100\left(\frac{R\text{-}S}{R\text{-}W}\right)$$

where

R = the ash content of the refuse.
S = the ash content of the feed.
W = the ash content of the washed coal.

Once an accurate determination has been made showing the relationship between the washing loss and the percentage of float in the refuse, it is only necessary thereafter to run float-and-sink tests on the refuse to arrive at the loss.

Before leaving this subject of how to arrive at the true washery loss, may

TABLE 1: TYPICAL WASHABILITY DATA

Specific Gravity	(1) Weight, percent	(2) Ash, percent	(3) Cumulative Weight, percent	(4) Cumulative Ash, percent
Under 1.30	68.68	2.3	68.68	2.3
1.30-1.38	16.42	7.3	85.10	3.3
1.38-1.45	2.88	17.2	87.98	3.7
1.45-1.50	2.02	22.0	90.00	4.1
1.50-1.55	1.34	27.5	91.34	4.5
1.55-1.70	2.11	34.9	93.45	5.2
1.70-1.90	1.15	51.5	94.60	5.7
Over 1.90	5.40	67.1	100.00	9.0

TABLE 2: TYPICAL WASHING DATA

		(1) Weight, Percent	(2) Basis 100 Tons Raw Coal, Tons	(3) Ash, Percent
Feed	Float	90.00	90.00	4.10
	Sink	10.00	10.00	53.10
		100.00	100.00	9.00
Washed coal	Float	99.66	89.25	4.00
	Sink	0.34	0.30	33.96
		100.00	89.55	4.10
Refuse	Float	7.18	0.75	16.04
	Sink	92.82	9.70	53.69
		100.00	10.45	50.99

Loss of recoverable coal = 0.45 tons.

Percentage loss of recoverable coal $= \frac{0.45}{90.0} = 0.5$ percent.

Efficiency = 99.5 percent.

I digress for a moment to point out the importance of taking good samples in laying a foundation for future determinations of washery losses?

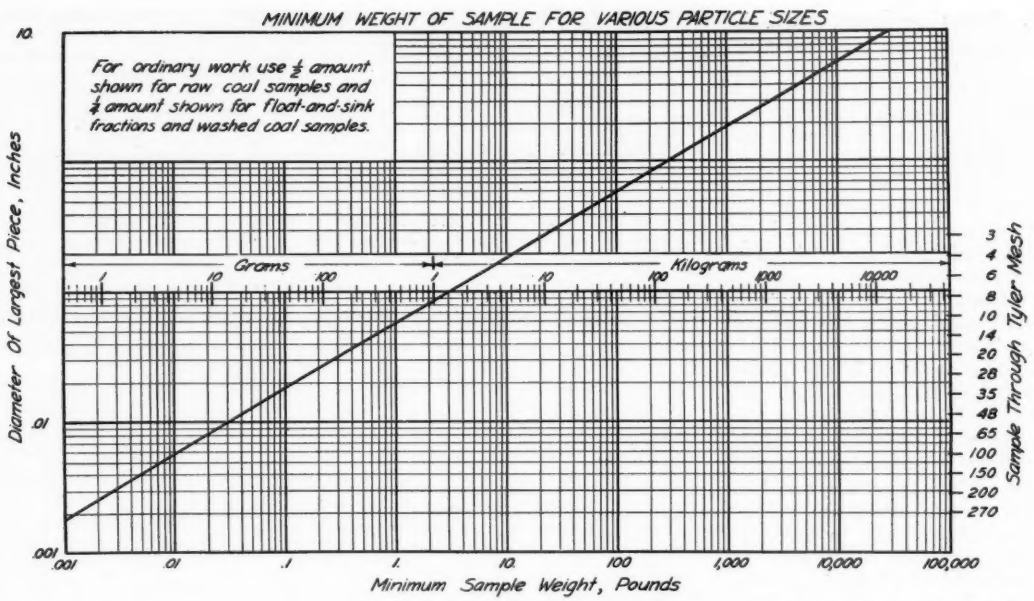
In recent years a great deal has been written on sampling but almost none of it applicable to the present situation where great accuracy is essential. For this reason I am including in Figure 1 Battelle Institute's sampling chart. This has been in daily use for many years where nearly every test gives a check on its accuracy. If the samples for the determination of the washery loss are taken in 20 or 25 portions over a reasonable sampling period and the total of all portions is equal to the weight shown in this chart, a very high degree of accuracy can be obtained in the sampling.

Correction of High Washing Losses

Suppose an operation proves to be inefficient and to show a high loss of coal in the refuse. What are some of the causes? One, a most important cause, is poor adjustment of the washer. Another, the usual alibi for poor results, is overloading the washer but in the average case overloading has little meaning, for most washing equipment must be readjusted for high tonnages and, as that is usually not done, overloading is more often than not a question of poor adjustment. But perhaps the most important one, and one that should be easy to correct is pure neglect to keep the equipment operating efficiently. This comes about from failure of the management to keep close tab on the operation by some systematic means.

In most cases these causes of inefficiency are relatively simple to correct. The answer is to be found in a study of the given washer. Often the manufacturer of the equipment can be called in to advantage to assist in running down the trouble and securing an efficient operation. However, sometimes the washers are inefficient and the answer then is a supplementary washing device to reclean the refuse. All of the equipment manufacturers have some washers that can be adapted to this purpose.

If additional equipment is installed, perhaps I should remind you as to what to expect in the way of a product. It will naturally be a marginal type of material that barely belongs in the washed coal. In Table 1 we found that the last products added to the washed coal, those lying between


MINIMUM WEIGHT OF SAMPLE FOR VARIOUS PARTICLE SIZES
For ordinary work use ½ amount shown for raw coal samples and ¼ amount shown for float-and-sink fractions and washed coal samples.
Diameter Of Largest Piece, Inches
Grams
Kilograms
Sample Through Tyler Mesh
Minimum Sample Weight, Pounds

Battelle Institute sampling chart

Data for low-grade or very uniform ores taken from Table 5, page 1130, Handbook of Ore Dressing, Taggart, 1927

1.45 and 1.50 specific gravity, were very high in ash content. Accordingly sound reasoning would lead one to make a very high ash product from a supplementary washing operation to add to the primary washed coal. When this is done, it will sometimes be necessary to pull more refuse from the primary washer in order to lower the primary ash content of the washed coal somewhat. In other words, it will be necessary to remove most of the sink material in the primary washed coal in order that it may absorb a high-ash product from a rewash system without unduly raising the ash content of the final product. That this is the correct procedure has been shown in the earlier discussion of "exchange" in coal preparation, wherein one gains or loses recoverable coal by trading marginal materials of high ash content. In other words, to use an example, one can gain by substituting a 20-percent-ash coal from a rewash system for a 40-percent-ash sink material in the washed coal.

Losses Through Failure to Crush and Reclean Middlings

The appearance of the product to be sold is the deciding factor in domestic sizes rather than ash or sulphur content. Commonly this necessitates cleaning the coarse sizes at a relatively low specific gravity. In consequence a high percentage of reject is necessary and this will usually contain a considerable percentage of recoverable stratified materials that can be crushed and retreated to advantage. Take the case of the coal shown in Table 1. Suppose the separation is made at 1.45 specific gravity. It will be noted that the float-and-sink fractions between 1.45 and 1.55 analyze 22.0 percent and 27.5 percent ash, respectively. In other words, they contain a high percentage of combustible materials. How much saleable coal can be recovered by crushing and rewashing? The answer requires float-and-sink tests in each individual case, but an approximate figure obtained from the study of a number of actual cases is 50 percent.

Suppose this figure is applied to the coal shown in Table 1. There is a total of 3.36 percent of this size between 1.45 and 1.55 specific gravities and in this particular coal this size constitutes 70 percent of the mine output. This means that (50) (70) (3.36) percent of the mine output can be recovered or 1.18 percent. Suppose in practical operation that 1 percent additional is recovered. On an output of 300 tons per hour this is 3 tons per hour or 21 tons per day. This is well worth while, but in many cases the recovery would be higher because in this coal the percentage of near gravity materials between 1.45 and 1.55 specific gravity is not particularly high.

As a general working principle one can safely say that in any case where a coal requires a separation below 1.50 specific gravity, the company is losing a substantial percentage of recoverable coal if it is not crushing and retreating middlings. In a jig plant, this means retreating the coarser sizes from a second refuse elevator. In washers making only two products, washed coal and refuse, it means crushing all of the coarse refuse and retreating it in the same washer. However, this scheme is usually not economical where mechanical loading is used because so much barren material must be crushed. This leaves as the only alternative some supplementary washer to separate secondary coal from the primary refuse before any crushing is done.

In the average washing operation at 1.45 specific gravity, a rewash system will recover coal worth $20 to $50 per day and about all that is required in the way of additional operating expense is the power to operate the washing unit. Such a saving will rapidly pay for the necessary equipment to recover the coal being lost.

Losses Through Cleaning of all Sizes at One Gravity

The preceding discussion about the importance of crushing middlings leads naturally to another source of losses at many operations, namely, the loss through the cleaning all sizes in one washer at the same washing gravity. If appearance is the deciding factor in the choice of a low-gravity separation on the coarse sizes, it follows that the smaller sizes are being washed at a lower specific gravity than necessary. This is one of the most im-

portant sources of loss in the case of any washing system involving only a one-gravity separation, that between coal and refuse. It is not at all uncommon to find $50 to $100 a day of recoverable coal being lost in this way even in a moderate sized coal cleaning plant.

In many cases the only method of recovering small coal that has been washed at too low a gravity is to install an auxiliary washer to reclean the refuse. This might take the form of a second cleaning unit of the same type or of another unit of a different type. However, to those who have jigging installations another alternative is open and that is to adjust the jig so that less cleaning is done on the fine sizes than on the coarse. This can be accomplished by using more water than is necessary, for the excess water will reduce the amount of the suction. This automatically results in a higher gravity separation on the fine sizes but does not affect the cleaning of the coarse sizes. At the present time a number of jigging plants are being operated in this way with a 1.45 specific-gravity separation on the coarse sizes to give a product of good appearance and with a gradually increasing gravity of separation on the finer sizes up to 1.55 or 1.60 specific gravity. The net result is a marked increase in the yield of saleable coal in the fine sizes where ash content rather than appearance determine saleability.

Losses Through Mixing Raw Coal With Washed Coal

The practice of washing coarse sizes and by-passing the fine sizes is becoming very common. Although it saves the cost of cleaning the fine sizes by a dry method or saves the cost of drying the fine sizes if they are cleaned by a wet method, the result is a loss of merchantable coal. This comes about from the fact that the fine sizes usually contain more or less high-ash impurities. In order to have the washed coal absorb these impurities it is necessary to clean the coarser sizes to a comparatively low ash content, even in some instances to wash the coarser sizes to an ash content equivalent to 1.45 specific gravity or lower.

In Table 3 is a typical set of figures from an operation where the raw coal is by-passed in an unwashed condition. The first column shows the ash contents of the mixture shipped. The second shows the corresponding yields when the fine sizes are by-passed in an uncleaned condition. The third shows the yields when the fine sizes are cleaned. The fourth shows the washing gravity for the coarse sizes when the fine sizes are by-passed. The fifth shows the working gravity when all sizes are cleaned.

TABLE 3: RESULTS OF MIXING WASHED AND UNWASHED COALS

Ash in the Final Mixture Percent	—Yield of Final Mixture— With Fine Sizes By-passed Percent	With Fine Sizes Washed at the Same Gravity as the Coarse Sizes Percent	——Washing Gravity—— For Coarse Sizes with the Fine Sizes Unwashed Percent	For All Sizes Washed at the Same Gravity Percent
4.5	89.2	93.2	1.37	1.64
5.0	92.6	94.5	1.49	1.82
5.5	94.6	95.6	1.61	1.98
6.0	96.0	96.5	1.84	2.06

Sizes washed are those shown in Table 1 and comprise 70 percent of run-of-mine. Unwashed sizes analyze 7.5 percent ash.

The figures, particularly those for a low-ash mixture, show a substantial loss in yield through the practice of blending the fine sizes of raw coal with prepared sizes. For instance in preparing a mixture analyzing 4.5 percent ash, the table shows a loss in yield of merchantable coal of 4.0 percent as compared to cleaning all sizes at the same specific gravity. The amount of the loss naturally depends upon how much shale or other high-gravity materials are in the small sizes, in other words, upon how much material there is in those sizes that has an ash content considerably above that corresponding to the true washing gravity. For instance in this coal the material right at the dividing line in a separation at 1.45 specific gravity contains 19.5 percent ash. (This is the elementary ash for this coal at 1.45 specific gravity.) In adding uncleaned raw coal to a washed coal prepared at 1.45 specific gravity, the "exchange" problem previously discussed operates so that a material of 19.5 percent ash is being sent to the refuse in order to include materials running 70 to 80 percent ash in the prepared mixture, a truly uneconomical procedure if the weight percentages involved are large.

The dividing line between where this procedure is economical or uneconomical is not difficult to determine in general. Suppose the cost of washing, dewatering and drying ½-in. by 0-in. sizes is $0.14 per ton, it is evident that a coal company can afford to lose $0.14 worth of coal in such a blending procedure providing the mixed product is marketable. If the cost of dry cleaning is $0.05 per ton, the company can evidently afford to lose that amount in the form of a low recovery before going to cleaning the fine sizes. Of course, if the small pieces of shale and high ash bone left in the prepared mixture cause fractures in coke, then regardless of the profit angle it is necessary to clean the fine sizes in some manner.

Loss of Coal in Sludge

This form of loss is the most controversial of all, for many companies claim they cannot market sludge at a profit, particularly sludge high in sulphur or lacking in coking properties. I am not prepared to answer these statements for all cases, but I see a definite improvement in the market for fine coal and my judgment is that most of the fine coal could be sold at a profit if the coal companies really thought so. I have in mind an Illinois company that some five or six years ago, when every one in that area was wasting most of their 5/16-in. by 0-in. sizes, set out in a serious way to sell those sizes. They started with a well-prepared product, wet-washed and dewatered. Then they searched for customers who could burn this material and proved to them that it was uniform and desirable. What was the result? This company actually developed a demand for 5/16-in. by 0-in. sizes.

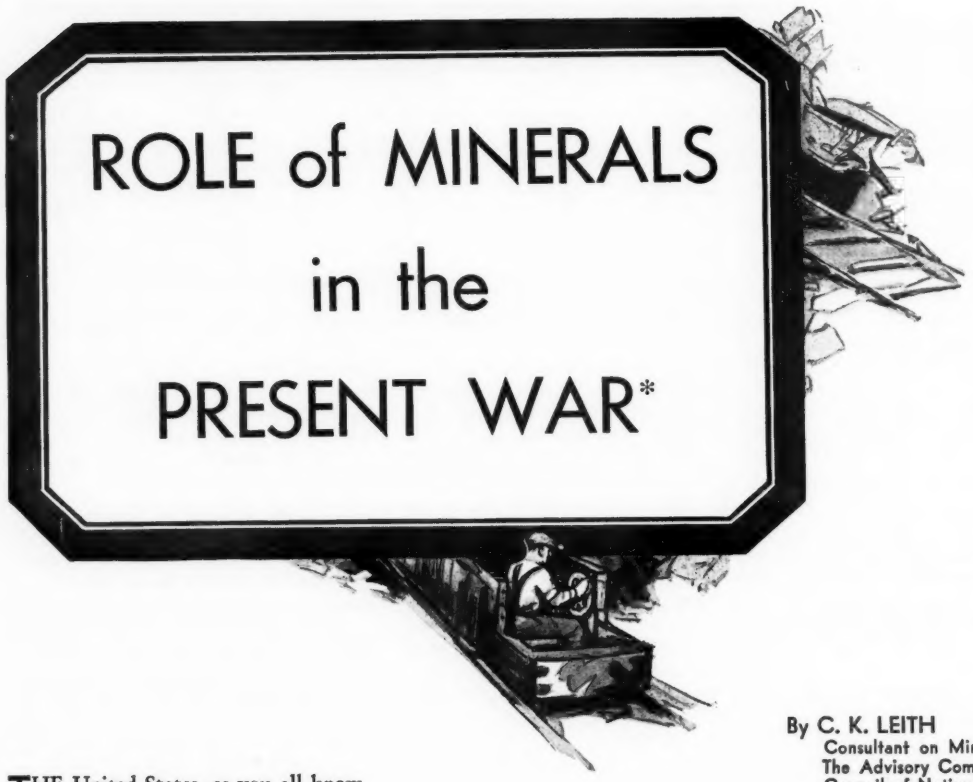
The situation is different today; sizes down to 10 mesh find a ready market. Now the thing to do is to apply the technique of the Illinois company to the fine size; namely, good preparation and true salesmanship.

Conclusions

There are many sources of loss in coal preparation that are being overlooked by the management of coal companies. Most of these come about through "exchange" of materials of moderate ash content for those of high ash content. In other words, they come about through the rejection of products of 20 percent ash, for example, while products of much

(*Continued on page 59*)

ROLE of MINERALS in the PRESENT WAR*



By C. K. LEITH
Consultant on Minerals
The Advisory Commission to the
Council of National Defense

In his opening remarks Dr. Leith pointed out he was not speaking officially for the National Defense Commission—that, having talked on this subject for a good many years, he was speaking on his own.—*Editor's Note.*

THE United States, as you all know, is well supplied with minerals—the best supplied of any country on the globe; but it still lacks several minerals, in part or in whole. In fact, the list is rather a long one.

Minerals Classification

The official classification of minerals in Washington includes (1) "strategic"—the minerals that we are really short of in substantial quantities ; (2) "critical"—the ones on the border; and (3) "essential"—the ones essential to war, and for which there are no particular problems of supply.

These three classifications are not particularly well-named. If one goes to a dictionary and looks up the meaning of the terms "strategic," "critical," and "essential," he is likely to be confused. As a matter of fact, a triple classification of that sort is highly artificial because, from time to time, minerals which are classed as critical may become strategic; or those classed as essential may become critical or strategic. During the progress of the last war, there were many such shifts between the classes, and we have already gone far enough in the present emergency to know that these classifications will not hold.

On the official strategic list are only nine: antimony, chromium, manganese, mercury, mica, nickel, quartz crystal, tin and tungsten.

On the critical list, there are several minerals, including aluminum, asbestos, graphite, platinum and vanadium.

Special Problems May Appear

The essential list includes minerals like oil, coal, iron ore, lead, zinc and copper. In this list there are no outstanding bottlenecks which appear yet, but during the last war in practically all of them there were special problems. We had plenty of iron ore, for instance, and still have. There is sufficient production of iron ore to meet almost any contingency, but at almost any time a demand might arise for a special grade, which makes trouble. I remember, in the last war, certain ordnance specifications called for iron of a lower phosphorus content than any produced in any of our ranges. We made a careful canvass of the amounts available by selective mining, and found that the burning of pyrite imported from Spain produced a sinter that was very low in phosphorus. That sinter became immediately a very important element in the program. It was needed so badly that, when it was discovered that a lot of the sinter had been dumped on the banks and used for road building, we had to dig up a few banks and old roads to get the material.

So, as the situation develops, we shall probably see these bottlenecks develop from time to time through the list of essential minerals, although every effort is being expended to foresee as many as possible and take steps to prevent them.

I might go on and give you many instances. There are plenty of clays in the country, in immense variety; yet we do not have all the varieties, and for some special types of manufacture foreign clay is imported. During the last war, we were importing foreign clay to the extent of about two or three hundred thousand tons per year. When this was cut off to save that much shipping space (we thought that would be easy) we im-

* Address presented to Annual Metal Mining Convention of The American Mining Congress, Western Division, Colorado Springs, Colo., September 16, 1940.

mediately met with a protest from a number of industries that domestic clays would not meet the situation.

Another illustration that might interest you: There is plenty of salt in this country, particularly in the salt beds of Michigan and New York. We found we were importing two or three hundred thousand tons of salt from the Mediterranean. Needing shipping space, this was cut off, thinking there was plenty at home. Then things began to happen. The Gloucester fishermen sent a complaint and explained that the fish along the coast had been salted from time immemorial with imported salt, and that without imported salt the fish could not be processed, and without salt fish we could not win the war. The next delegation came from the Chicago packers and called attention to the fact that particular varieties of salt were necessary to pack their meats, and that their contracts with the Allies specified Liverpool and other types of foreign salt. We had scarcely recovered from that when a third delegation arrived from the dairy producers of Wisconsin, complaining that domestic salt could not be used in packing properly the dairy butter, and, of course, we could not win the war without butter.

Some of these things are just beginning to appear. We do not know where they will develop, so the entire list must be carefully watched.

Government Purchases for Stockpiles

At the outset, of course, primary attention is being given to the strategic minerals, and our problem there is to keep industry supplied, to keep industry stocks up, and at the same time to build up a stock for use in emergency through Government purchase.

The Government purchases were started only a short time ago, and, since normal shipments are already being interfered with, the double task of keeping industry supplied and building up the stocks is being necessarily retarded.

As to the method of computing stockpile requirements, nobody knows what stock of any particular mineral is necessary to provide against an emergency. For the time being, we are figuring the emergency on a two-year basis—but this, of course, is subject to continuous change as special situations develop.

Then the question comes up, what kind of production or capacity should be counted on? Should it be based on past records of consumption, or on the assumption that there will be capacity consumption over the period? We are in favor of basing it on capacity consumption during an emergency.

Also, in building up the stock, allowance is made for production from domestic mines—in other words, what can be developed and recovered from domestic sources during the emergency. I need not explain to this group that this is a highly difficult question. Estimates vary widely as to the amount that can be secured of any particular material, the time for its development, the costs, and so forth. But after a very careful study, with the aid of all the talent that could be brought into the job, liberal estimates have been made of what we think the country might be able to produce in an emergency, and these subtracted from the total of stock to be bought.

Further, in the emergency there will be substitutions, and there again, it has been necessary to make an estimate of the amount of substitution possible. Various specialists have made estimates and we have come to a fair agreement as to what substitution may amount to. Allowance is being made for this in building up the stockpile.

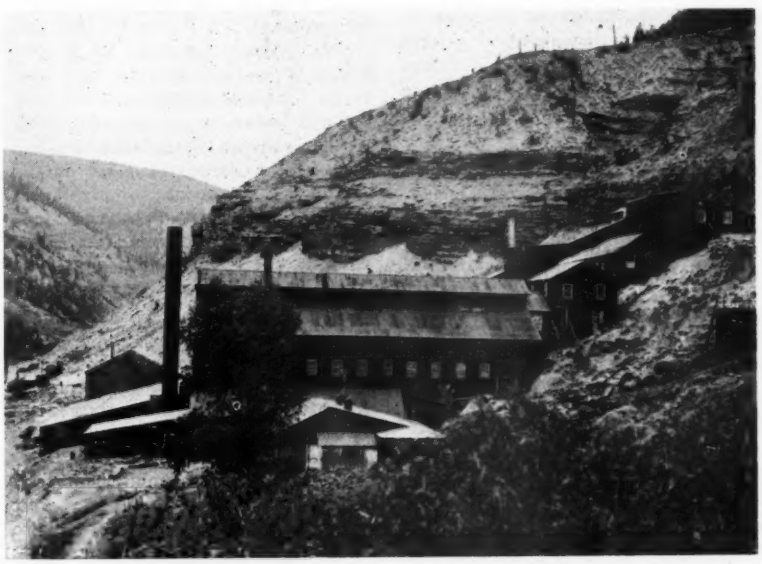
Further, there are a great many technological advances in the use and consumption of minerals. These developments are occurring day after day, and we know already there are certain savings possible in the use of these materials. For example, we have had a report on manganese indicating what the steel industry could do in a pinch in using less manganese, and this is being taken into consideration.

Still further, account must be taken of the new provision that exports of these strategic minerals can be made only through license. These minerals are cut off unless given special permits for export, and that is adding to our potential supply.

In figuring the stockpile, also, we are in favor of ignoring, for the time being, the stocks in the hands of industry. Some people say that plenty of these minerals are stocked up by industry—for a six months' or eight months' or year's supply, or a year and a quarter—and that the stockpile requirements should be reduced to take at least some of these into account. If we knew we were going to war tomorrow, we would immediately start to figure industry stocks into our calculations; but such stocks can go up or down. History has shown that one time they are high and the next they are low. No one knows when the critical day may come, and the stocks that are high now might be depleted a few months hence.

Domestic Producers Not Being Discriminated Against

The public has heard so much of the stockpile program that there is a great deal of repercussion in Washington from domestic producers who have gotten the notion that the buying of foreign ores is cutting out domestic production, and that domestic



Vanadium mill at Vanadium, Colo. There is at present quite a stir in mining activities in this locality

producers are being discriminated against. That simply is not the fact.

Every possible allowance is being made for production from any property in the United States from which an output of usable grade is possible within a reasonable time and at anything like a reasonable cost. The following steps are being taken to insure that result.

In the first place, standard grades of minerals in the strategic list are being purchased at terms satisfactory to the Government as they are offered. Also, certain contracts are being made for the purchase of materials which will allow the opening up of new deposits and give the producer a chance to write off the new investment.

Specifications Being Revised

Secondly, we are revising specifications. The original specifications were drawn up at times before the emergency was imminent—drawn up for a long-time program, with the idea of getting the very best, high-grade material which would always be good, to be used as a reserve with which could be mixed a certain amount of lower grade material in an emergency. That was a sound idea when it was formulated; but to follow it now would seriously hamper the stockpiling program. Industry itself is already relaxing these standards in a variety of ways in order to get the necessary supplies. We are now recommending the revision of Government standards to approach the extent being followed by industry.

We are not in favor of going so far as to relax standards and enforce practices which would be inefficient and costly. It is to be remembered that our industries have to be kept up as nearly as possible to a peak of efficiency, and while there are certain low grade ores that can be used in an emergency, it always means high cost and loss of efficiency. So we are not going as far in that direction as some people would like. But we are doing what seems reasonable, to an extent that will interfere in the least possible way with industry cost, and yet substantially enlarge the amount of the domestic and foreign ore to be made available under present conditions.

Studying New Recovery Processes

In the third place, we are studying new processes for recovery of minerals from low grade domestic deposits. As you know, there are many low-grade manganese and chrome deposits, and people have been active in developing processes to extract material from these low-grade deposits. Some of these processes are sound and are pretty well proved; others are still in the doubtful stage; and still others are away out on the fringe with only remote possibility of success. But all these processes are being studied. For instance, for the recovery of manganese and the recovery of tin from scrap, technologic committees have been appointed by the National Academy of Sciences, composed of the best experts that could be found in the country, to review all the processes and set them out in the order of their cost and practicability, and to report to us. Our actions are based largely on their recommendations. In this program we have also had the very effective assistance of the Bureau of Mines, and have called in specialists from the industries on a great many of these questions.

Stockpiling Proceeding Slowly

The net result of all the efforts so far has been that industry stocks are being pretty well maintained; but the building up of an extra stock required by Government for an emergency is going ahead rather slowly for various reasons. Conditions abroad were disturbed before the program was started, and shipments are now being cut off here, there and everywhere. We have had some very interesting episodes in getting chrome out of Turkey, for instance, after the Mediterranean was closed off, and recently it has been virtually impossible to get manganese out of Russia for the same reason. When Germany took over France it was necessary to move fast to get Chinese tungsten and antimony through Indo-China, a French colony.

Practically all of the world has had to get away from the easy, normal commercial method of simply saying so much is wanted at a certain time. Each purchase is a special case, involving ships and political affairs. There are all kinds of complications.

Quite a number of contracts have been made for materials abroad, but many of these contracts call for deliveries this year, next year, and the year after. Some of the contracts run as far as 1944. The amount now ordered for government stockpile is far from estimated requirements and the amount actually here is a great deal less. Full delivery depends to a considerable extent upon the events which may occur during the next two or three years.

So we think the only course now is to drive ahead just as quickly as possible to secure both domestic and foreign ores while the going is good, with the possibility that the emergency may come at any time. There is no likelihood we will over-shoot the mark that is being set up.

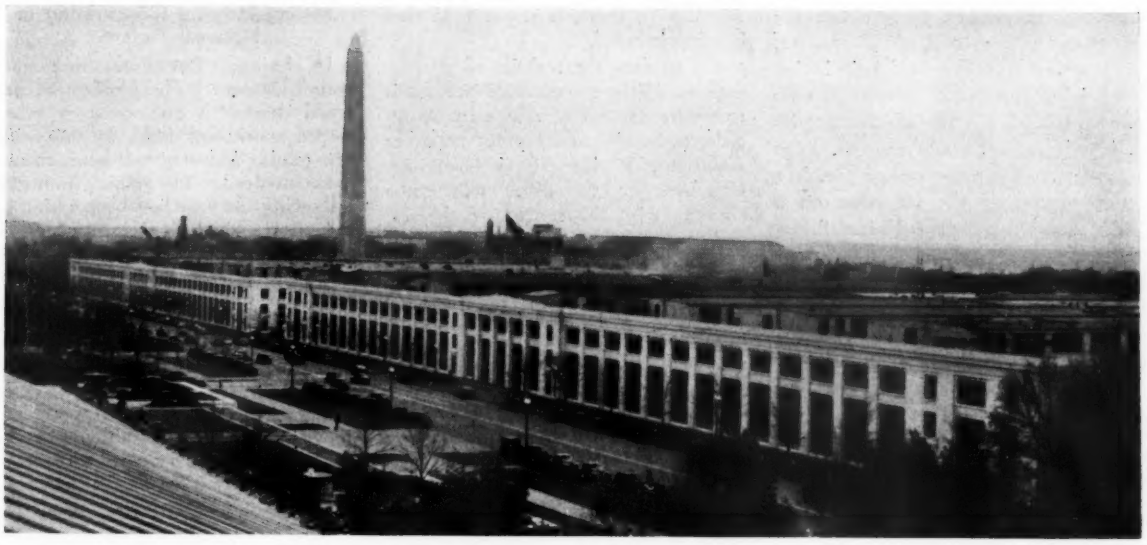
Main Concern With National Emergency

In the general field of domestic development, I would like to call attention to another question that has come up repeatedly—the question of projects looking toward the future development of the country. Some of these look pretty good; others are nothing more than explorations. Some of them are pretty visionary. But they are all in Washington. They are there by hundreds. It is necessary to review the entire series to separate the good ones from the bad.

We are operating under this principle: That our concern is primarily with the emergency of national defense and not primarily with the future development of the country, however desirable that may be. We are all in favor of development, but for the National Defense Council to spread itself over the field to develop all the mineral possibilities in the country by supporting this, that, and the other enterprise, many of which will not come through at all, in effect will be building on sand. You cannot build defense on possibilities of the future. You must build on certainties and practicable prospects.

To draw the line between the proposals which will bring sure results and those that may bring doubtful results in the future, presents a great deal of difficulty; there are a great many marginal cases. In spite of our emphasis on the immediate things, the sure things, I think that out of this program will come developments which will inure to the future benefit of the United States and the mining industry. Certain of the deposits which are opening up and certain new processes which are being supported should, somewhere along the line, bring results which will be permanent, or which will last us after the emergency has passed.

There is another element in this problem that has been very much to the front—the effort of people who are developing minerals other than strategic minerals to get endorsement from the national defense program. There is a great deal of pressure being put on Washington to transfer certain minerals out of the essential class



Munitions Building, Washington, D. C.

into the strategic class. The moment a commodity is classified that way, the man who is looking for financial support finds it easier to get it from the government or industry. I do not say that all these efforts are being made only for the purpose of getting money. Most of them are honest. Some people who are opening up deposits have not had the chance to look over the whole field, and they feel that they are actually contributing something to the country.

Status of Foreign Countries

I would like to spend just a few moments now on the broader aspects of the problem of minerals in the war, what is going on on the other side of the waters, and what the general set-up is.

Germany started this war in a position of very great inferiority in regard to mineral supplies. That was very well known, and as a matter of fact, Germany's desire or purpose of improving her mineral position was one of the announced principal reasons for Germany going into the war.

Modern wars are mechanized. Mechanization means minerals, and minerals are moving into war on a scale that has no precedent in history. Whatever the ambitions are, military or otherwise, the limit is set by the amount of minerals that can be turned into war materials—guns, airplanes and the mechanical appliances of war, and the power to drive them.

Germany's Mineral Problem

Germany has expanded and very greatly improved her mineral position. She has taken over the iron ores of Sweden, northern France and Luxembourg; certain zinc deposits in Belgium and Poland; and she has obtained part of her oil supply from Rumania. She has an immensely increased amount of smelting capacity, and has picked up large additional coal fields. But she has not solved her mineral problem by any means. She still needs nickel, copper, tin, adequate quantities of oil, tungsten, vanadium, mica, quartz crystals, industrial diamonds, antimony, zinc. She needs the ferro alloy minerals in general.

Position of England

England, with its control of the sea, still is in a markedly superior position, because England can get not only the essential minerals, but the minerals which are strategic and critical to her. If Germany is to win, the fight must go on until control of the sea makes it possible for Hitler to supplement his present supplies.

At the beginning of the war, the balance of power, so far as the basic raw materials for fighting the war were concerned, was so overwhelmingly on the side of the Allies that many of us fell into the error of assuming that of course the Allies would win. I say "error"—I mean what might be error—we can not be sure. I took part in this discussion, like many others. We felt pretty sure of our ground, but our conclusion was based on a fallacious assumption. It is one thing to *have* mineral reserves, and another to *use* them. It was assumed that the Allies would use their reserves on somewhat the same relative scale as Germany. Reliance was placed on the Maginot line to hold the situation long enough to bring the reserves into action. On that element of the prediction we were wrong. They did not get started. Their potential weight of metal was not brought into the situation at the right time.

If England can hold control of the seas, she can still have hope for the ultimate outcome, because control of the seas means control of materials necessary to build the implements to fight modern war.

U. S. Position Similar to England's

Turning to the United States—it is very much in the same position as England. It starts out with an overwhelming superiority in mineral supplies, but is not completely supplied, as indicated by our earlier discussion. There are a number of minerals needed from outside. It is sometimes said by people not familiar with minerals that the entire import of minerals is only a small item, running only into a few tens of millions of dollars, so why worry? But when we think of the kinds of materials needed—tin, manganese, chrome, tungsten, and others—we see that they are very essential to modern industry. They include a large part of the ferro alloys, so essential to steel. In other words, without these minerals, the machine will not run. It is like taking a wheel out of a watch, or essential parts out of an automobile.

With control of the sea, the United

States is in position to dominate the situation. With control of the sea, it is able to go the full limit in industrial development for modern war. But to hold control of the sea its minerals must be *used*, and in huge amounts. We must realize the fact that control of the sea takes on a new significance. The United States is the largest producer and largest consumer of minerals in the world. It depends on foreign countries for supplies and markets. Our mineral domain is literally world-wide. There is no redistribution of raw materials among the nations that we can keep out of. In short, it is our field that is being invaded.

Let us face the realities of the situation. Hitler's announced purpose is to secure control of raw materials in order to be able to carry out his other ambitions. He is out for a showdown. One side or the other will come through with the control of the sea, and that side will be the one which brings to bear the greatest weight of its mineral supplies. Unless we put into motion our present potential weight of metals, we might just as well make up our minds the ultimate result will be a change in our way of life.

Mining Industry Cooperating in National Defense

In closing, a few words on a more optimistic note. The problem of national defense is one which is being shaped more and more by minerals. The mining industry will be more and more involved. The mining industry is showing the very best cooperation in the effort which is being made. I speak from personal knowledge. It is coming forward with the maximum of help, and with the minimum of self interest. As far as anyone can make a safe prediction in these troubled times, it is that the mining industry can be counted upon to do its share of the job before us.

Strategic Mineral Procurement†

By ELMER W. PEHRSON
Chief Engineer, Metal Economics Division, and Acting Chief, Economics and Statistics Branch, Bureau of Mines

I BELIEVE it can be stated without exaggeration that our strategic mineral position is not alarming despite belated action. At present the official list contains only nine minerals classified as strategic; and, with the possible exception of tin, the outlook for supplies for at least a year, and in most instances two years, is good, due largely to the foresight of industry in building up large stockpiles and vigorous government action in recent months. This does not mean that we can continue to use strategic minerals extravagantly or procrastinate in developing additional sources of supply, because such security we now enjoy will carry us through only a relatively short period in terms of the protracted emergency that may impend. We can, however, take time to consider our problems carefully and avoid some of the hasty and costly decisions made in the last war.

Nine of Fourteen Strategic Materials Are Minerals

Strategic materials are those essential to national defense, for the supply of which in war dependence must be placed in whole, or in substantial part, on sources outside the continental limits of the United States, and for which strict conservation and distribution control measures will be necessary. The most recent list, issued in January, 1940, contains only 14 commodities, including the following nine minerals—antimony, chromite, manganese ore (ferrograde), mercury, mica, nickel, quartz crystal, tin, and tungsten. The nonmineral commodities are coconut-shell char, used as an absorbent in gas masks; manila fiber for rope, which still is virtually indispensable to the Navy; quinine for medicinal purposes to protect troops from malaria; rubber; and silk, needed for making parachutes and highly essential for powder bags used in loading large-caliber guns, where a full-burning container is required that leaves no glowing ash that might ignite subsequent charges prematurely. Eight of the nine minerals now classified as strategic were included on the original list issued by the War Department in January, 1921. Quartz crystal was designated as strategic in 1938. The 1921 list contained 42 commodities, 19 of which were minerals. Besides the eight already mentioned, arsenic, asphalt, graphite, nitrogen, phosphorus, platinum, potash, sodium nitrate, sulfur, uranium, and vanadium were included. Aluminum was added in 1936 but was removed in 1940. Although the decline in the number of strategic minerals has eased the procurement problem to some extent, the great increase in consumption of manganese, tin, chromite, nickel, and other strategic minerals since World War I has added complications, so that it is difficult to say whether or not our strategic mineral situation has improved to any extent since 1918.

Critical materials are those essential to national defense, the procurement problems of which in war would be less difficult than those of strategic materials, either because they are less essential or are obtainable in more adequate quantities from domestic sources. Fifteen materials, including aluminum, asbestos, graphite, platinum, toluol, and vanadium, are now classified as critical.

In addition to strategic and critical materials, the Army and Navy Munitions Board maintains surveillance over certain other materials highly essential to industrial preparedness but which might become strategic or critical. This list is not made public.

Procurement plans are those confidential government documents that contain plans for government action, to be put into effect as an emergency approaches. For the strategic commodities they include comparisons of

† Presented at the Annual Metal Mining Convention, Western Division, The American Mining Congress, Colorado Springs, Colo., September 16-19, 1940. Published by permission of the Director, Bureau of Mines, U. S. Department of the Interior.

estimated requirements and available supplies for the emergency period and recommendations as to how deficits are to be met. Heretofore, official plans have covered only a two-year emergency period, but in view of present world conditions some feel that preparation for a three-year or even longer period would be justified.

Army and Navy Munitions Board Responsible for Procurement Planning

Several agencies in Washington are concerned with procurement planning. The President, of course, as Commander-in-Chief of the military forces, heads up all national defense activities. Under him is a vast organization to handle the multiplicity of detail. Much of it is found in the regular Government departments, but newly created agencies gradually are assuming more importance as the volume of work increases. In recent years the Army and Navy Munitions Board has been chiefly responsible for preparation of the procurement plans for raw materials. This was established in 1922 by the Secretaries of War and Navy to deal with, and render decisions upon, industrial planning problems requiring coordination of Army and Navy procurement activities. The Board, which consists of the Assistant Secretary of War and the Assistant Secretary of the Navy, functions through an executive committee and staff, largely Army and Navy officers. Its Commodities Division maintains extensive files of data on minerals and other materials, and the task of procurement planning is delegated to commodity committees composed of representatives of the Army and Navy who in turn gather information from every available source. A Minerals Advisory Committee of civilian experts advises the Board on mineral matters. Last year 17 commodity reports were prepared for the Board of subcommittees of industrial specialists working under the direction of the Minerals Advisory Committee, of which Dr. C. K. Leith is chairman. The Board determines which commodities shall be considered strategic and critical and recommends quantities and specifications of materials to be purchased under the Strategic Materials Act, about which we shall hear more later.

The Assistant Secretary of War is also directly concerned with strategic minerals. Under the National Defense Act of 1920, he is charged with responsibility for adequate planning of industrial mobilization, in which raw materials play an important part. The functions of this office are coordinated closely with those of the Army and Navy Munitions Board, but statutory responsibility for certain phases of the work resides with the Assistant Secretary of War.

Surface cropping of manganese, Philipsburg, Mont.

Interior Department Surveys Domestic Resources of Strategic Minerals

The United States Department of the Interior, through the Bureau of Mines and the Geological Survey, makes an important contribution to procurement activities through its investigation of domestic resources of deficient minerals and research on methods of processing low-grade domestic ores that may be used in an emergency. The basic statistics compiled by the Bureau of Mines are, of course, indispensable in procurement planning, and the Bureau's commodity specialists are consulted frequently by all agencies involved in the national defense program. The Secretary of the Interior shares responsibility with the Secretaries of War and Navy, through the Army and Navy Munitions Board, for purchases under the Strategic Materials Act.

The Council of National Defense, composed of the Secretaries of War, Navy, Interior, Agriculture, Commerce, and Labor, was established in 1916 to facilitate coordination of industry and resources for the national security and welfare. Since the National Defense Act of 1920 its functions have been delegated to the Office of the Assistant Secretary of War, and the Council has been inactive since 1921. It is of interest now chiefly because the law creating the Council also authorized the appointment of an Advisory Commission of seven members; this old statute is the authority under which the present Advisory Commission to the Council of National Defense has been established.

National Defense Commission Organized

The Advisory Commission was organized in May of this year immediately after Germany marched through Netherlands, Belgium, and northern France with such outstanding success. Its chief function is to translate legislation on national defense into action and accomplishment. It is composed of seven departments—industrial materials, production, labor, transportation, consumer protection, agriculture, and prices. The President is the designated head of the organization, and one of the White House secretaries serves as executive secretary of the Commisson. Responsibility for raw material supplies is assigned to the industrial materials department, of which E. R. Stettinius, Jr., is commissioner. This department is divided into three industrial divisions: Mining and mineral products, agricultural and forest products, and chemical and allied products. Dr. Leith is the chief consultant on minerals and is assisted

by a group of industrial specialists. The mineral group was organized on June 3 and immediately began coordinating the procurement activities of various Government agencies. Studies of the strategic and critical mineral industries were inaugurated with a view to recommending revisions in existing procurement plans necessitated by rapidly changing conditions. Representative groups from industry were called to Washington for consultation, and out of the discussions came first-hand information on the bottlenecks in the supply picture and methods for meeting them. The minerals division has had excellent cooperation from the regular Government agencies and considering the late start has achieved an enviable record of accomplishment.

The National Defense Commission is now purely an advisory group and has no statutory authority to enforce its recommendations, but with minor exceptions its suggestions have been well-received by the agencies legally responsible for mineral procurement. Its present advisory status eventually may be changed. The industrial mobilization plan prepared by the Army and Navy Munitions Board under authority of the National Defense Act of 1920 contemplates creation of a civilian War Resources Administration to carry out the industrial mobilization program when a war emergency is envisioned. Presumably the present Defense Commission may become a forerunner of this agency if our involvement in the present conflict becomes imminent. Before actual declaration of war the proposed War Resources Administration would function under authority now vested in the military departments, but during a war emergency it will become an executive agency of the Government, responsible directly to the President and charged with the industrial mobilization of the nation.

Principles of Procurement Planning

Under the guidance of such an array of ability, it is not surprising that strategic-mineral procurement is moving forward under full steam. The problem is being attacked in three ways: By stockpiling, by expanding domestic production, and by conservation measures. Years ago some believed that the problem of deficient minerals could be solved only by providing stockpiles, but in later years students of the strategic-mineral problem are in general agreement that domestic deposits, though low in grade, should be considered as a supplemental source of supply. No one can foresee the length of an emergency, and consequently no one can guarantee that a stockpile accumulated in advance will suffice. Moreover, there are practical considerations, such as cost and market conditions, that preclude unreasonably large accumulations. Thus a sound program of preparedness in strategic minerals should include not only stockpiles as a first line of defense, but plans for emergency use of such resources as we have at home. This policy was recognized by the manganese subcommittee of the American Institute of Mining and Metallurgical Engineers in its 1932 report to the War Department, in which it recommended government research to develop processes for treating low-grade domestic ores for emergency use and stockpiling as a solution to our manganese problem. A similar plan was proposed by the Bureau of Mines in April, 1938. At present our stockpiling program is far from complete, and there is much uncertainty as to our ability to maintain communications with those oversea sources from which large tonnages can be obtained. Domestic production has therefore assumed an even greater significance in procurement planning.

Stockpiling Advocated by War Department

The principle of stockpiling strategic materials for national defense purposes long has been advocated by the War Department. Recommendations to that effect have been included for many years in the procurement plans prepared by military officials, and the published annual report of the War Department for the fiscal year 1927 called attention to the desirability of building up stocks of deficient raw materials. Until recently, however, when the European situation became so aggravated that it was obvious a world crisis was imminent, no specific requests were sent to Congress for funds with which to purchase and store strategic materials. In retrospect it is easy to criticize this seeming negligence on the part of the Government, but when we consider that the period from 1920 to 1935 was an era of disarmament treaties, government economy, and catastrophic depression, when expenditures for national defense were decidedly unpopular, we can understand why government officials did not request funds beyond those necessary to maintain the already sadly depleted defense facilities.

Congress has made some effort to create peace-time domestic production of strategic minerals through tariff protection, but the adoption of stockpiling as national policy was never given serious consideration until recently. During the past two or three years legislation has been enacted that will go far toward solving our strategic-material problem. There is some question, however, as to whether we can attain full realization in the present emergency of the stockpile objectives now considered necessary.

Congress Endorses Principle of Stockpiling

The first official acceptance of the principle of Government stockpiles was made in the Navy Department appropriation bill for the fiscal year 1937-1938, in which Congress allotted a small sum for the purchase of strategic materials to be stored for emergency use by the Navy. The Strategic Materials Act (Public 117—Seventy-sixth Congress) which became law in June, 1939, finally established a sound basis for attacking the strategic material problem. The bill authorized the expenditure of $100,000,000 over a period of four years for stockpiling purposes and in addition provided funds for an investigation of domestic resources of strategic minerals and for developing methods for treatment and utilization of low and off-grade ores.

Government Actively Buying Minerals

Two Government agencies are engaged in buying minerals for stockpiling purposes—the Procurement Division of the Treasury Department and the Metals Reserve Company, a subsidiary of the Reconstruction Finance Corporation. The Procurement Division derives its authority from the Strategic Materials Act. To date $70,000,000 has been appropriated to carry out the provisions of the Act.

Early in May it was evident that the national defense program would have to be revised in the light of the intensified mechanized warfare Germany was waging and that the entire program needed speeding up. The methods of purchase prescribed by the Strategic Materials Act did not permit buying by private negotiation, and the slower procedure of advertised bidding was entirely unrealistic under conditions then prevailing in world markets. Moreover, the funds available under the bill were inadequate to complete a satisfactory stockpiling

program. For these reasons it was decided to transfer the procurement of some of the major items on the strategic materials list, such as tin, manganese, and rubber, to the Reconstruction Finance Corporation where speedier methods of purchase could be adopted. This was accomplished by creating the Metals Reserve Company, an organization with $5,000,000 capital, to which the Reconstruction Finance Corporation authorized loans of $100,000,000 for financing the purchase of tin, manganese, and other metals. Later appropriations under the Strategic Materials Act have authorized the Procurement Division to operate by private negotiation so that public bidding no longer is mandatory.

The Navy Department formerly was in the market for small quantities of strategic materials, but appropriations to this agency were discontinued after passage of the Strategic Materials Act. The Navy expenditures totaled only $4,500,000.

The funds available to these three agencies total $174,500,000, most of which is available for mineral purchases. In addition, the Reconstruction Finance Corporation has loaned $140,000,000 to a subsidiary, the Rubber Reserve Company, for acquiring and carrying a reserve supply of crude rubber. This makes a total of $314,500,000 already available for strategic material purposes. According to some authorities, an ideal stockpiling program would cost about $800,000,000, of which $400,000,000 would be required for minerals. The $314,500,000 will thus provide only part of the maximum requirements, but it is believed that the sum is adequate to pay for all materials that can be delivered from accessible sources of supply within the next year or two and afford reasonable protection, particularly in view of the large stocks now held by industry.

In making purchases under the Strategic Materials Act, the Secretary of War, the Secretary of the Navy, and the Secretary of the Interior, acting jointly through the Army and Navy Munitions Board, are authorized and directed to determine which materials are strategic and critical and the quality and quantity of such materials to be purchased by the Procurement Division. To administer this provision of the Act, the three Secretaries have created what is known as the Army and Navy Munitions Board Committee on Strategic Materials, Specifications, and Storage, consisting of representatives of the departments at interest. The committee has recommended purchases of tin, ferro-grade manganese ore, tungsten ore, metallurgical-grade chromite, quartz crystals, mica, and mercury, in addition to several non-mineral commodities. As stated previously, buying of manganese and tin recently was transferred to the Metals Reserve Company.

High-grade Materials Specified for Stockpiles

In inaugurating the stockpiling program a year ago, the question of specifications was carefully considered. It was concluded that in the best interests of national defense the materials going into the stockpiles should be of high quality to assure flexibility in use. As regards tin, for instance, purchases were restricted to metal of tinplate grade because tin cans for food constitute the most essential use from a military point of view and tin of this quality also would be suitable for virtually all other uses. Such a stockpile would assure wide latitude in the allocation of tin to various industries under emergency conditions. Stockpiles of high-grade manganese ore, chromite, and tungsten were desirable because by admixture it would be possible in an emergency to use substantial quantities of low-grade ores available domestically. Thus a stockpile of high-grade ore would afford more protection than one of lower grade.

Unfortunately, under present conditions it is very difficult to obtain high-quality products in large tonnages, and in view of the urgent need for building up stockpiles it has been necessary to make moderate revisions in specifications for some commodities.

Government Buying Domestic Materials

There has been some complaint that the Government does not want to buy domestic materials for its stockpiles. This is untrue. The Government is interested solely in building up as rapidly as possible a stockpile of *standard-grade* ores for national defense purposes. Any legitimate offer that meets specifications, and where delivery can be guaranteed, receives careful consideration, regardless of source. There is no discrimination against domestic products. In fact, the Strategic Materials Act makes liberal concessions to domestic producers on terms of delivery, bond requirements, and price, and substantial quantities of domestic ores already have been purchased or contracted for by the Government. Much off-grade material has been offered which industry cannot use, and some bids have been submitted where there was no hope of delivery. Naturally these proposals have been turned down. One point that should be clearly understood is that the Government is attempting to avoid competing with private industry for supplies of strategic minerals, and wherever possible consumers receive first consideration.

Government Assisting Domestic Production

The stockpiling program is being pursued aggressively, but domestic resources are receiving considerable attention as well. The Bureau of Mines has examined 242 deposits of strategic minerals and undertaken exploratory work on 16. Some 50 additional projects have been planned, for which appropriations are now pending in Congress. A very large proportion of the deposits examined offers little hope of commercial production under normal conditions, but a majority could supply some strategic minerals in the event of acute shortages and these deposits, though small, are significant from the viewpoint of national defense. The Geological Survey also is playing an important role in this appraisal of domestic resources through its geological investigations of strategic mineral deposits which have been expanded during the past year. The Bureau's metallurgical activities have been intensified, and funds have been appropriated, subject to recommendation by the National Defense Commission and release by the War Department, for pilot-plant testing of methods developed to treat low-grade manganese ores. If the pilot-plant operations corroborate the results obtained in the laboratory, a practical method of producing usable grades of manganese will be available for emergency use; but probably at some increase in cost.

Meanwhile, the Metals Reserve Company, in cooperation with the National Defense Commission, has negotiated contracts that will bring several new domestic plants into production, and others are being considered. The Defense Commission also has established technical committees under the auspices of the National Academy of Science to consider and advise on the feasibility of new technologic processes proposed for treatment of domestic ores.

In regard to the stimulation of domestic production the consensus among officials in Washington is that a general appeal for increased production of strategic minerals should be

avoided. The Government is prepared to consider giving assistance, by purchase contract or otherwise, to any sound proposal for increasing production, wherever increased output is required for national defense purposes. This policy is being pursued to avoid a repetition of the War Minerals Relief aftermath of the last war. No one should risk producing strategic minerals from submarginal deposits with the expectation that the Government will reimburse him for losses at some later date.

Conservation Sound Policy in War as Well as Peace-time

Prudent use of our precious and limited mineral resources should always be encouraged as part of a sound national conservation program, and this policy should continue even in war-time.

Whenever stockpile reserves and domestic supplies are inadequate to meet emergency requirements, rigid conservation measures must be invoked. For most minerals, reasonable restrictions can be adopted that will effect a considerable saving without too much sacrifice in cost or efficiency of production. One of the most effective conservation methods is substitution, but the Army and Navy Munitions Board wisely has established the policy that the use of substitutes in an emergency should be confined to products whose qualities have been demonstrated under peace-time commercial conditions. To impose large-scale substitution on industry at a time when the industrial machine is expected to deliver its maximum effort merely invites disaster. Drastic conservation measures should, therefore, be avoided, if possible, and every effort is being made to this end. However, in view of the late start on the stockpiling program, for some minerals it may be necessary eventually to impose rather severe limitations on use if an emergency overtakes us in the near future. This phase of the procurement problem is being studied by the National Defense Commission.

Restriction of exports is an effective way of achieving conservation, and this already has been invoked by recent presidential proclamations placing exports of strategic and critical materials under license control. This action undoubtedly has imposed some hardship, but because the continuation of large foreign shipments would have jeopardized the national defense program, the national interest required that this trade be brought under Federal control.

Secondary Metal Industry of Vital Importance

One of the most valuable assets of this nation from the viewpoint of mineral preparedness is our secondary metal industry. During the last war it played an important part in meeting metal requirements and will contribute an even greater part in any future emergency. Production of secondary metals relieves the strain on our primary metal facilities, and the large reservoirs of scrap permit rapid expansion of supplies during peak demand. As a source of supply and as an outstanding contributor to practical conservation, this industry occupies a prominent position in procurement activities.

Up to this point this discussion has been confined more or less to organization and procedure. I will now outline the high-lights of actual accomplishment and the present status of the more important strategic minerals.

Tin Most Serious Problem

Tin is probably our most serious problem, primarily because of our dependence on Asiatic sources of supply. Domestic deposits offer little hope of assistance in an emergency, and we shall, therefore, have to rely largely on stockpiles, Bolivian production, and conservation measures. The stockpiling program is progressing as well as can be expected. Up to July 1, the Procurement Division purchased approximately 6,000 tons, and since then the Reconstruction Finance Corporation through the Metals Reserve Company, has negotiated a one-year contract with the International Tin Cartel under which the Cartel has agreed to remove virtually all restrictions on production; and the United States has guaranteed to buy all surplus tin produced at 50 cents per pound. With favorable conditions, the Government may acquire as much as 65,000 to 75,000 tons under the agreement. Several thousand tons already have been purchased. Negotiations for the construction of a smelter to treat Bolivian ores are under way. Several substantial tin interests are willing to cooperate with the Government in this venture, so that a satisfactory solution of the problem is anticipated in the near future. The Bolivian mines probably could supply about half of our requirements. Various conservation measures are being studied, and export control has been established. Industry stocks are considerably above normal, and at present the quantity of tin afloat to the United States is the highest on record. All told the tin situation, though far from satisfactory, is not alarming for the immediate future.

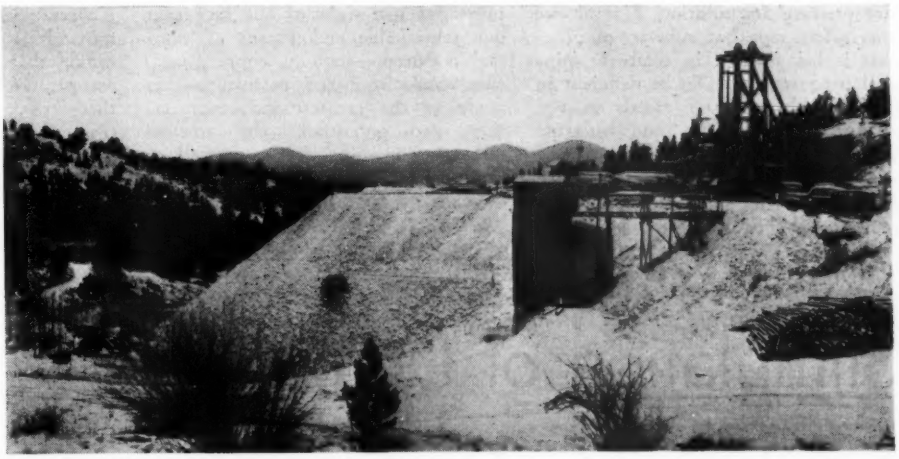
Manganese Program Well Advanced

The outlook for manganese is better than that for tin, despite the fact that annual requirements for high-grade ore under full-capacity steel operations (73,000,000 long tons) would reach the unprecedented total of 1,250,000 long tons. Nevertheless, at present a two-year supply is almost in sight. Industry has on hand over a year's requirements at current rates of consumption. Domestic production is now small, having declined from an annual rate of 67,000 tons in February to 35,000 tons in July, but these rates will be greatly exceeded in the near future. The Metals Reserve Company has contracted for 250,000 tons to be obtained from Butte over a period of three years, and other contracts completed and pending will make available additional quantities from domestic sources. Contracts have been made with Cuban producers that will increase their production capacity and provide substantial tonnages for the Government stockpile. The Bureau of Mines project, previously mentioned, may pave the way for domestic output on a larger scale. Stockpile purchases from domestic and foreign sources, for delivery within one to three years, are about the million-ton mark. Thousands of tons already are stored and deliveries at an accelerated rate are anticipated.

The main weakness in the manganese situation is that such security as we have is contingent on industry maintaining its present inventories until the stockpiling program is completed and the various projects for increasing domestic output come to fruition. As long as this situation continues, we face the possibility of being projected into an emergency with industry's stocks depleted and our procurement plan incomplete. The abrupt drop in imports in June was very disturbing, but fortunately August receipts have been reassuring.

Stockpiling of Chromite Proceeding Slowly

Purchasing of chromite is proceeding rather slowly, although substantial quantities have been obtained from Turkey and Rhodesia. At present, the Government is buying only metallurgical-grade ore, supplies of which are none too plentiful abroad



Illinois mine, The Wolf Tongue Mining Company, Nederland, Colo.

and extremely limited at home. Later in 1939, 25,000 tons of Alaska ore were purchased for six months delivery. The contract expired last May, and although a six months' extension was granted no deliveries have been made to date. Shipments from Turkey via the Mediterranean were halted temporarily when Italy entered the war, but recently some cargoes have been cleared through British and Italian officials.

The outlook for domestic supplies is improving. As a result of the exploratory work by the Bureau of Mines it has been demonstrated that important reserves of off-grade chromite are available in Montana, and there are favorable indications in other states. Processes for converting these off-grade ores into products satisfactory for metallurgical use are being investigated, and negotiations are under way that may result in a sizable increase in domestic production. Industry stocks are exceptionally high and are greater now than at the first of the year.

Tungsten Situation Improving

The tungsten situation is less favorable than that of manganese and chromite. Imports have continued at a high rate, and production this year is higher than in 1939. Consumption also has gained, so that there has been only a slight improvement in industry stocks since January. Until recently the stockpiling program was not making much headway, because industry was absorbing nearly all available supplies, but in June the Government was fortunate in making a large purchase of Chinese ore. Negotiations for moving this material through Indo-China were proceeding by cable about the time France collapsed. The shipment was delayed, presumably by Nazi interference, and for a while it appeared that the cargo would not be released by the new French government. However, after strong diplomatic representations the ore was cleared and has arrived in the United States. This addition to stockpile reserves, together with activities under way to increase domestic production and imports from South America will ease the anxiety over the immediate outlook for tungsten.

Mercury Production Responding to High Prices

The rapid increase in the price of mercury during the past year has stimulated production and reduced consumption so that the country is now more than self-sufficient. Large exports in recent months have depleted industry stocks to some extent, but shipments abroad are being curtailed under the present export licensing system. Acquisition of a moderate-size stockpile has been authorized as a safety measure against possible future deficiencies in domestic production.

Certain grades of sheet mica used in airplane sparkplugs and radio condensers are essential in the aircraft program, and the procurement problem is complicated by the strict control exercised by the British government over supplies from India, which is by far the principal source. Industry stocks of mica splittings are quite large, but a reserve supply is greatly desired as a defense measure. A method for obtaining adequate stockpiles of the strategic grades is now being worked out, and recent developments suggest that some may be obtained from domestic sources. Conservation measures are being developed for use should acute shortages occur.

Nickel and antimony are available in adequate quantities in neighboring countries, so that no major procurement problems are anticipated in the near future. The present political situation in Mexico is causing some concern regarding the security of the supply of antimony ores from that country, but Bolivia, and the large low-grade reserves in Idaho, indicated by the Bureau of Mines exploration program in the Yellow Pine district, provide alternate sources of supply.

Quartz crystal of piezo-electric quality is used in radio-frequency control mechanisms, which are indispensable in military communication systems. There are no substitutes for this type of quartz, and Brazil is virtually the only source. Industry has fairly large stocks on hand, and in addition a government stockpile is now being accumulated.

The foregoing summary indicates that the outlook is fair for strategic mineral supplies for the next two years. But let me emphasize again that much of this security is based on the large stocks industry now has. Should supplies from abroad dry up, as they well may, industry stocks would be depleted rapidly, leaving the country facing a possible emergency a year or so hence with its main protection gone. Full preparedness in minerals will not be attained until the Government possesses adequate stockpiles and has carefully considered plans available for utilizing our domestic resources. While much has been accomplished along this line, there is even more yet to be done.

Although many serious problems

are pressing for solution, I think we can safely say that substantial progress is being made in strategic mineral procurement. To be deficient in such highly essential metals as tin, manganese, chromium, and tungsten is indeed unfortunate in an era of highly mechanized warfare. But we must not lose sight of the fact that our remarkable endowment of mineral resources—such as copper, lead, zinc, coal, iron, and petroleum—has made us the greatest industrial nation, and potentially the greatest military power on earth, as well as the most self-sufficient of the great powers. Our deficiency in certain minerals is a minor weakness in our armor that can be strengthened by comparatively small effort. We should therefore continue our efforts in mineral preparedness until our objectives are achieved. We cannot risk an Achilles heel in our national defense.

Stimulation of Domestic Production of War Minerals*

By J. R. VAN FLEET
Vice President
U. S. Vanadium Corp.

ALL mineral supplies are flowing toward industry on schedule. There have been very few interruptions, and these have not been due so much to war interruptions as to shipping interruptions—mostly freight rate interruptions.

The producers of these minerals are receiving very little more this year than they did two or three years ago for their products. The high prices existing today are caused by high freight rates on those materials which must be hauled a long distance by sometimes circuitous ocean routes. You can't exactly blame the shipping industry for that. But in spite of the lack of shipping on some of the materials, both chrome and manganese are coming to the United States in excess of requirements, so that there is no emergency at present on the two principal materials which we were concerned with—the materials which we use in the largest tonnage.

In spite of that fact we have to look ahead. If we wait for an emergency to get busy, we then will have to draw rapidly on our stockpile, whatever it might be at that moment.

It is up to our own mining industry to supply the minerals necessary to prosecute a war when an emergency arises and when these minerals cannot be secured from other places.

South American Sources of Strategic Minerals

Some of the strategic minerals and materials are available in South America but we have not cultivated—in the last few years—South American sources. During the last war we secured a considerable tonnage of chorme ore from Brazil. It helped tremendously. In the last few months, the imports or shipments from Brazil have been practically nothing; only a few hundred tons a month, and it has been months and years since there have been importations of consequence. That situation should be remedied.

Bolivia affords another example of a source of these necessary minerals and this source should be cultivated. Formerly Bolivia marketed most of her tungsten in Europe. Since this tungsten is what we term "off-color" or below standard, and as long as we could get Chinese and high quality domestic tungsten, we did not make use of that mined in Bolivia. It was, therefore, marketed in Europe, but these markets are fast disappearing for the South American mineral industry.

Besides the tungsten in Bolivia, there is tin, which is going to be used. And antimony. Bolivia, as a matter of fact, is the largest producer of antimony in the world. Yet we have purchased from Bolivia, I think, in 1939, only about a thousand tons—one-eighth of its production.

Likewise, Chile produces manganese, and during the last war we were glad to get it. We haven't used much manganese from Chile in the last few years, but it is beginning to arrive again. I think the first six months of this year there were about 10,000 tons imported. The resources are not extensive in Chile, but it helps.

In the West Indies and in Central America there are also occurrences of the minerals we use.

If we consider that we must go to South America for some of these minerals—manganese from Chile; tungsten from Argentine, and also there have been some offerings of manganese from the Argentine; manganese from Brazil; tin, tungsten and antimony from Bolivia; and chrome from Brazil—which resources can be further developed, we must include in our program the stimulation of the source of supply of these minerals in South American countries.

Stimulation of South American Sources

To stimulate that source of supply, it is only necessary to buy the product. We are doing that to some extent. Industry, however, cannot refuse to take materials of higher grade or from regular contractual sources of supply, and replace them with a new source of supply; that would be very foolish. But, if we consider that the South American countries are a potential source of supply for these materials, we must develop those sources of supply; and any consideration for the procurement of these metals or ores in time of emer-

* Presented to Annual Metal Mining Convention, American Mining Congress, Western Division, Colorado Springs, Colo., September 16, 1940.

gency must also include the development of the South American sources of supply.

That will mean, in some cases, improving railroads, furnishing rolling stock, developing the properties and putting them into production.

U. S. Resources

The resources in the United States of chrome, manganese, tungsten, mercury are fairly well-known. Most of these resources have either been idle for the past twenty years or, in a few instances, such as in mercury and tungsten, they have been actively in production.

Tungsten

Tungsten is not extremely strategic at present. There is a good outlook for tungsten, and that situation has been brought about, which is important, by the favorable prices for tungsten which have existed over the last year.

Previous to that time the tungsten production was uncertain because the prices were uncertain, although there has been a steady improvement in production due principally to some permanent production operations.

Chrome

The case of chrome ore is different. There is no market for domestic chrome ore at the present time. Chrome ore is coming into the country in excess of the country's requirements. We cannot stimulate the production of an ore or supply unless there is a market for it. It is ridiculous to suppose someone would produce something he can't sell. Why is this? The reason is due entirely to the low price obtainable for domestic chrome ore.

First, this is due to quality. The domestic chrome ore is mostly of low quality. It has a high iron content. The standard specifications which the government compiled for stockpile purposes states that chrome ore must have a minimum of 48 percent of chromic oxide and the chromium to iron metal ratio must be at least three to one.

During the last war we produced a great deal of chrome ore in this country. For 1918, I think it amounted to something like 90,000 tons. I think the average of all the ore produced was close to 40 percent $Cr_2 O_3$. That is below the so-called standard.

Chrome ore consumers like to use high grade ore when they can get it, but, as has been stated on many occasions, our domestic chrome ore can be and has been used in time of emergency.

It is up to the mining industry, especially in the west where these minerals occur, to know about the existing resources of chrome ore and to be ready when the time comes. There cannot be a large production of anything unless there is plenty of that material. The known developed resources of chrome and manganese in the United States are rather small.

We had the experience in the last war of finding one deposit after another and I think that with the same intensive search additional discoveries will be made to cover another emergency. This opinion, however, has been questioned by qualified engineers. But we must do everything we can to find and to develop these additional new occurrences of both chrome and manganese.

The old-time prospector is fast disappearing, but there are numbers of young men who show active interest in the search for minerals. Few of them know about chrome, manganese and tungsten. Few of the old-time prospectors, or the younger ones, could recognize scheelite, for instance, in a contact-metamorphic tungsten deposit. They would probably think it some kind of gold, silver or copper-bearing mineral occurrence.

Must Encourage Prospecting

Something should be done to encourage prospecting.

The U. S. Bureau of Mines and the United States Geological Survey have done a vast amount of work this past summer in going over areas in which chrome and manganese were known to exist. The Bureau of Mines has done drilling on known occurrences and the Geological Survey has worked up the geology in other areas.

In my opinion, to stimulate prospecting and discovery of these necessary ores, the Bureau of Mines should establish headquarters in certain favorable areas, with qualified instructors in attendance where the young prospectors, or the old ones, could come for advice. Classes should be formed and instruction given about the minerals to be sought and the favorable enclosing rocks and structures. There is nothing like a good trip in the field with a man who can illustrate the practical application of the class teachings.

These young men could be selected from the mining districts, men who have a mining background. Most of them already know how to cook and pack and take care of themselves in camp, and in the mountains.

In my opinion it is just as important to enlist men in such service as it is to enlist men in the army and navy forces. The men in the line can't fight unless they have something to fight with. It is just as important for a young man to spend his time searching for things that we need as it is to be learning how to fight in the armed forces.

Utilization of Low-Grade Ores

Progress is being made in developing processes for utilization of the low grade ores we have in this country. Large sums of money are being spent in research and in the development of these processes.

Industry in the last 20 years has purchased every ton of domestically produced manganese that has been offered.

Industry does not always use a high-grade manganese ore. They do for some purposes, naturally, but there are many other products made with manganese that do not require a high-grade ore. Some can be high in silica; some can be low in manganese. Phosphorous is one thing everyone always has to guard against but this manganese ore also has its uses.

The same thing applies to chrome ore. There has been little production of chrome ore, but all the chrome ore which has been produced has been marketed.

I remember at the beginning of the last war we received $16 a ton for minimum 40 percent chrome ore loaded on the cars on the Pacific Coast. Twenty dollars a ton freight was paid on that ore to get it to the metallurgical plant. The price rose, from necessity, because $16 a ton wouldn't mine much ore; wouldn't haul it very far. We didn't have any good roads in those days—and that price didn't leave anything for profit. But I remember packing ore off a mountain, in California, and putting it on the car, after hauling it about 56 miles and selling it for $22 a ton. Now, there wasn't much profit in that, but we produced chrome ore. Prices rose and again the price will be sufficient to get out production.

Full Cooperation of Mining Industry Pledged

The mining industry has a job in case of emergency. We have to produce these necessary things. Our future depends on it. The safety of the country depends on it, without which we, as individuals, are not safe; our families are not safe. And I know that the mining industry will respond

if the time comes. Industry will respond. Industry will, I know, get out and do everything they can to get the materials they need. They did it before, and they will do it again.

There should be no distrust expressed or inferred as to the cooperation of industry. I know the mining industry will cooperate to the fullest extent.

— *Discussion* —

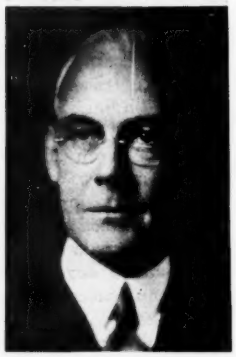
By ROBERT LINTON
Consulting Engineer
Los Angeles, Calif.

I WISH to discuss a few reactions and suggestions from potential producers who have come to me in connection with the work of a small committee on strategic materials appointed several months ago by the Los Angeles Chamber of Commerce, of which I was asked to serve as chairman.

The purpose of this committee was to amplify the information on deposits of strategic materials which we know exist in the southwest, to gather specific information about how much these might produce and what it would cost to bring them into production.

Those of us like myself who were trying during the last World War to bring deposits of manganese and other needed war minerals into production as needed will remember the feverish activity and wasteful methods which we had to follow in order to get the ores; but we did produce the ores. Production of metallurgical chromite rose in 1918 to about 90,000 tons, when, in 1913, according to the "Mineral Industry," the production had been only 255 tons. Manganese ore, metallurgical grade, which in 1913 had amounted to only 4,000 tons, in 1918 had risen to 350,000 tons. The grade was not the present required 48 percent for either chromite or manganese, but the important thing is that the ores were used and they did bring this country out of a very definite and difdifficult emergency.

We have run across several reactions which we have brought to the attention of the Advisory Committee of the National Council for Defense.



One is that the prevailing specifications for some of the ores, especially manganese and chrome, are too rigid to be met by a great many potential producers.

We agree with the policy of stock-piling of materials of the highest obtainable quality. Nevertheless ,we regard the program as one which should as far as practicable also encourage and stimulate bringing into production our own natural resources.

You can't open up mines overnight. We found that out back in 1917 and 1918. As a matter of fact, after the emergency developed, it was a year or more before mining the strategic minerals was really on an important scale. We believe that if there were a present market provided for such ores as can be produced, it would result in opening up some of the known deposits which we have in the southwest which are now inactive or undeveloped. I think that is probably more or less true all over the country.

I was very glad to hear Dr. Leith, mineral advisor to the National Defense Commission, say the matter of liberalizing specifications had already been considered; the sooner revisions can be announced, the quicker action there will be in getting new mines opened up.

Another reaction which we have gotten concerns difficulties of small producers in marketing their ores. Under the present procedure bids are submitted on a specific tonnage of ores of a certain grade. If arrangements were made by which carload lots of ore could be sold by small producers, delivering it to shipping points within reasonable hauling distance, I am confident that a considerable number of these small properties would be opened up.

These small deposits must be utilized if we are to get the full benefit of domestic production. It seems good policy to encourage bringing as many of them as possible into production now.

Working out beneficiation of the low grade ores is very important for both chrome and manganese. As has been mentioned, a great deal of work has been done by both the Bureau of Mines and by private interests, some of which seems to be quite encouraging. If the methods being developed should be perfected to the point of commercial operation and treatment plants built in the regions where there are considerable reserves of known ores, even if most of them happen to be small, it would provide a greatly enlarged market for domestic ores. A plant is projected in the vicinity of the Boulder Canyon hydroelectric plant to manufacture ferromanganese from ores available in that district. This would provide treatment not only for the ores which are owned and will be mined by the company which is to build the plant, but for custom ores which will be delivered to the plant by smaller potential operators in that region.

Included in authorization for federal appropriations is one of $2,000,000 for the building of plants in the vicinity of western hydroelectric power plants to make electrolytic chrome and manganese. If these plans are realized and plants put into operation which will receive and treat low-grade ores, it will result in the development of a number of properties which are now only prospective, most of which are small, but whose aggregate production would be considerable.

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The March of COAL MINING

Ten Years of Progress

The DEVELOPMENT of GATHERING HAULAGE for MECHANICAL LOADING

By G. B. Southward
Mining Engineer
American Mining Congress

IN THE development of modern coal mining over the past 10 years, the gathering haulage has come in for more changes than perhaps any other single phase of operation; this applies not only to the track arrangement but also to the material used in the construction. The evolution in the haulage has been gradual, and it is only when we think back to the first mechanical operations that we realize how extensive the total of these changes have been. Fortunately, however, they have been all for the better, and the gathering tracks of 10 years ago would make a very poor showing when compared to those in modern mechanical mines of today.

Service and Gathering Problems

In the earlier days of mechanical loading, with small capacity cars, slow car movement and excessive gathering haulage distances, the car change was a serious obstacle. For example, it was found that a small capacity car could be loaded by a machine in one minute, but when it required the locomotive two minutes to take the load away and bring back the empty, then the car change used up two-thirds of the time of the cycle. However, when large capacity cars were used which took, say, three minutes for loading, and when the track and switching arrangements were installed so that the locomotive could return with an empty in less than one minute, then the car change was reduced to 25 percent of the cycle, and the loading time was increased to 75 percent. This in effect is what has taken place in the development of mechanization, and it is now recognized that the fundamental requirements for efficient haulage are: (a) large cars, (b) good track to permit rapid movement, and (c) switches, located close to the working face, to provide for quick car change.

After the room track had been solved, it was discovered that this was only a part of the problem, and probably a minor part, and the real difficulty which then arose was to have ways and means for adequate haulage between the room neck and the main line. This problem became more complicated as the production from the loading machines increased, because of the fact that a gathering system that would satisfy an output of 100 tons a shift broke down completely or became too costly when a 300-ton loading capacity was reached. So we know today that gathering haulage in mechanical loading is not merely the operation of servicing cars to the loading machine, but consists in delivering large tonnages from a concentrated area to the main locomotive.

Examples of Modern Gathering

Figure 1 shows what a modern gathering system consists of and it should be stated that it required a number of years of trial and experiment before this plan was evolved. In examining this layout, the first thing to be kept in mind is that the territory is highly concentrated; the area shown on the map being only 1,700 ft. wide by 1,000 ft. deep, and in this area there are five mobile loading machines working—one on development, and four on room work. The coal is about 7 ft. high, and under conditions of this type a production of more than 1,500 tons a shift would be a usual performance.

Each mechanical loader is served by one eight-ton locomotive, and there are two intermediate or relay locomotives which deliver trips from the five service motors to the main line haulage. The track arrangement, as the plan indicates, has been very carefully designed, and adequate facilities are provided for rapid and concentrated movement, without delays.

The plan in Figure 2 is an entirely different mining system from that shown in Figure 1, in that a large percentage of the coal produced is mined from the pillars, and the track arrangement is designed accordingly. This operation is worked entirely with mobile loading machines, and the gathering system here again illustrates the importance of maintaining an adequate car supply.

The panel shown is worked with one mobile mechanical loader, which is served by two gathering locomotives, and each motor, after a cut is loaded out, takes its loads to the main line haulage. This, as will be seen, is some distance away, and as the mining system does not provide space for side tracks near the working faces, there are two service locomotives employed instead of an intermediate haulage.

Conclusion

After experience began to show that mechanical loading must have heavy rail, sufficient ties, good roadbed, and properly constructed frogs and switches, there was the thought in the minds of many men that the cost of these facilities would offset the savings made through machine loading. However, the result has been to reverse this idea; good track is real economy, and it is now known that hand loading had been working for years under a severe haulage handicap.

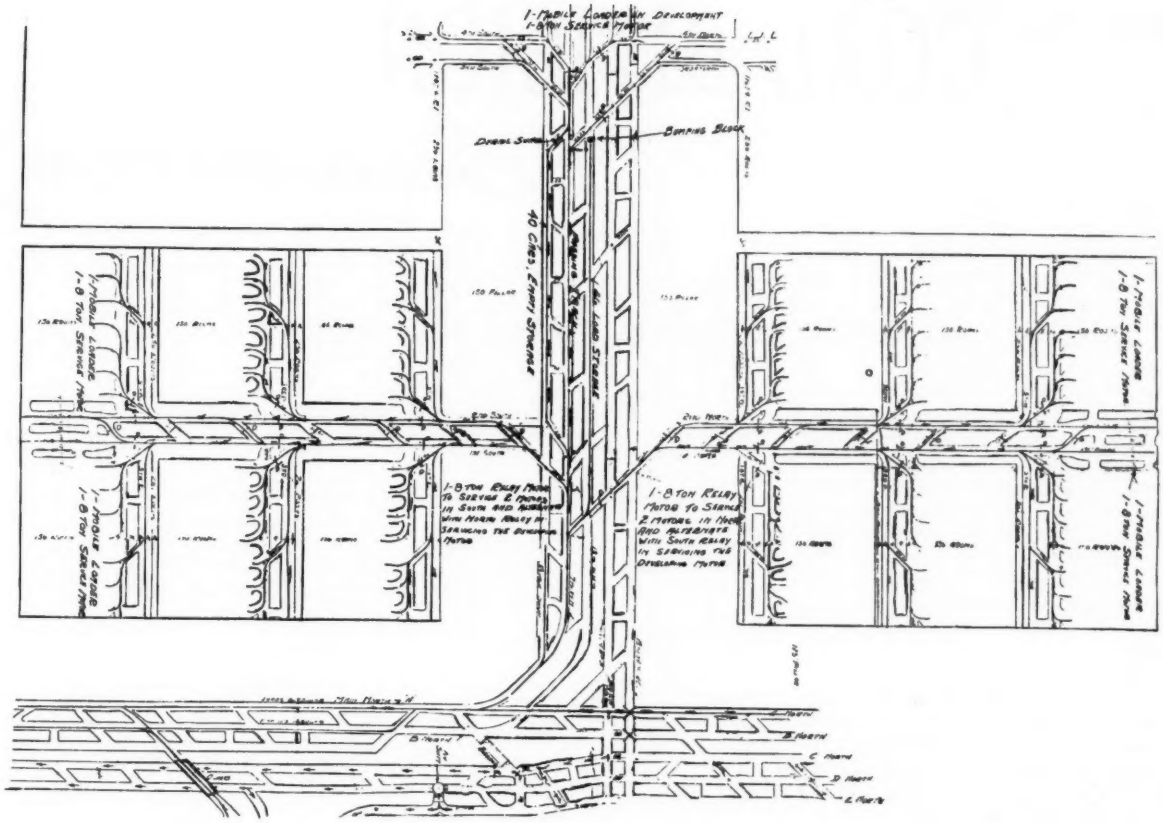

1-TROLLEY LOCOMOTIVE DEVELOPMENT
1-8 TON STORAGE MOTOR
DRIVING SLOPE
BREAKING BLOCK
40 CAR LOAD STORAGE
1-8 TON RELAY MOTOR TO SERVICE 2 MOTORS IN SOUTH AND ALTERNATES WITH NORTH RELAY IN SERVICING THE DEVELOPING MOTOR
1-8 TON RELAY MOTOR TO SERVICE 2 MOTORS IN NORTH AND ALTERNATES WITH SOUTH RELAY IN SERVICING THE DEVELOPING MOTOR
1-TROLLEY LOCOMOTIVE 1-8 TON STORAGE MOTOR
B. NORTH
C. NORTH
D. NORTH
E. NORTH

Fig. 1—Gathering haulage system for concentrated mining

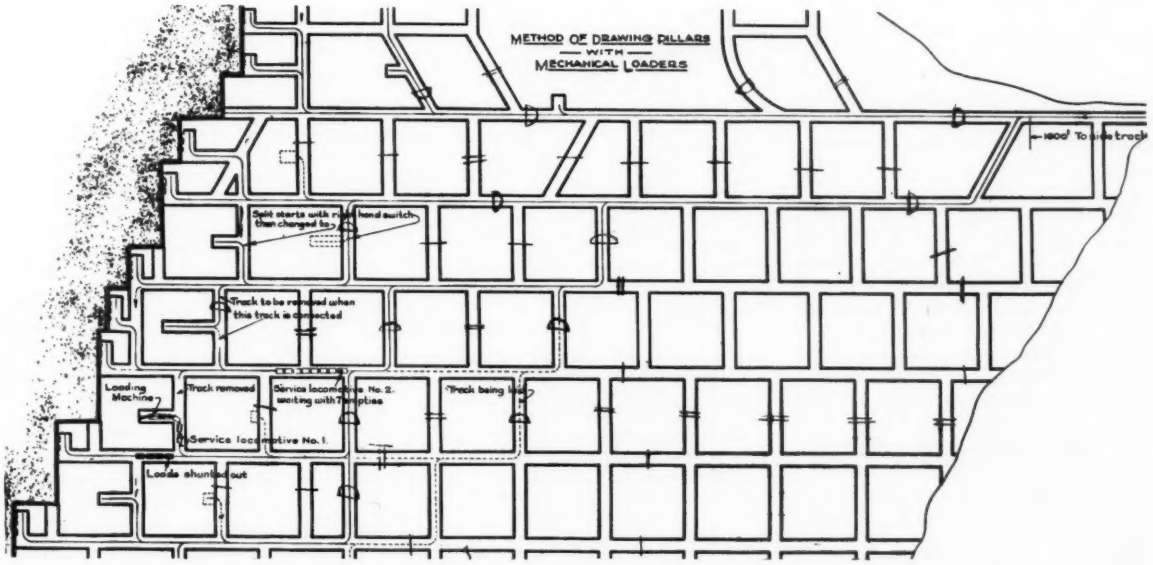

METHOD OF DRAWING PILLARS
— WITH —
MECHANICAL LOADERS
1800' To [illegible] track
Split starts with right hand switch, then changed to
Track to be removed when this track is connected
Loading Machine
Track removed
Service locomotive No. 2. waiting with Tow Motor
Track being laid
Service locomotive No. 1.
Loads shunted out

Fig. 2—Gathering haulage for block system

ANALYSIS OF MINE POWER DISTRIBUTION

● *A Report to the Power Committee*

THE electrical energy used by the various classes of equipment for the production of coal can be segregated readily from the total quantities purchased or produced by the use of electrical meters. When such meters are used, the records obtained can then be the means of determining the power cost for operating each class of machinery, the same as other mine costs.

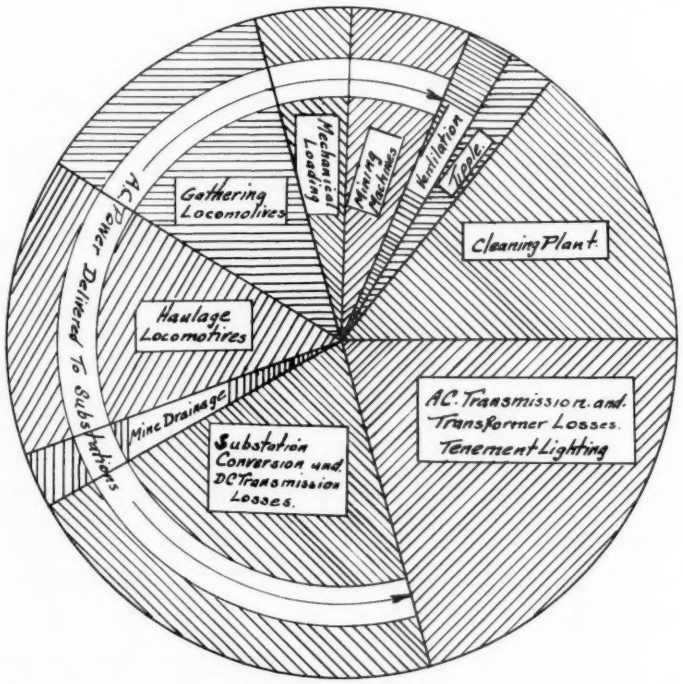
The records, when kept over a period of time, will be beneficial in that they will show the trend of power use which will point out where savings in energy consumption can be realized.

Studies have been made at three individual mines and the average information obtained at each mine has been used to prepare the three charts shown here. Beside each chart is shown the table in percentage of the total power use for each classification of equipment. This table also can be considered as showing the proportionate cost of the total power for each class of equipment; for instance, Chart B shows that 33 cents out of each dollar in power cost is used by ventilating fans. Notations are made on the charts showing the approximate average monthly tonnage of these three mines.

The proportionate part of power used for the various classifications is shown in the round chart. Each classification is labeled. The alternating current delivered to the substations for Charts A and C is further segregated into the various classifications of direct-current power use and also the proportionate part of the power necessary for conversion.

A short description of each mine might be in order. Mine A is a drift mine working a seam averaging about 48 in. thick. Alternating-current power use shown includes tenement lighting, cleaning plant, tipple ventilation and substations. At this mine, all coal is loaded mechanically. The pumps for mine drainage are all furnished with power by the direct-current power mine system.

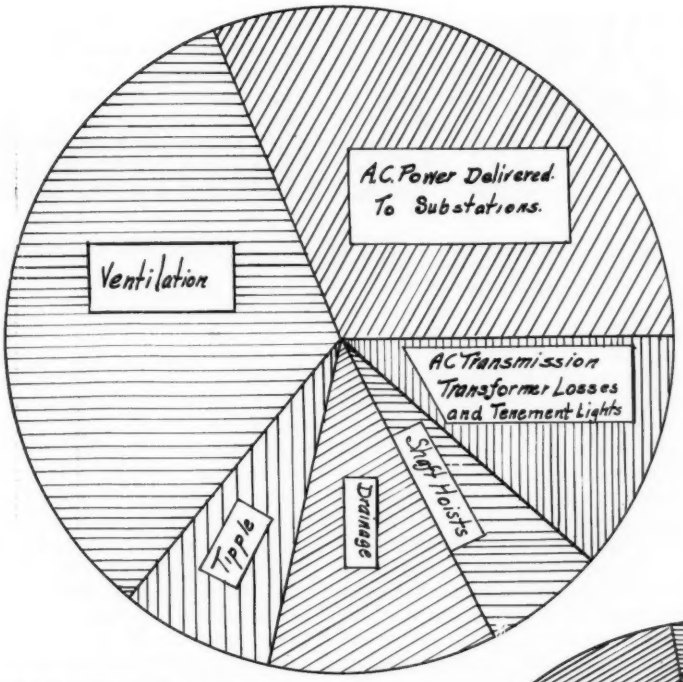
Mine B is a shaft mine, as will be realized readily by hoist power. A considerable quantity of gas is en-



POWER DISTRIBUTION—"Mine A"
33,000 Tons per Month

	Percent
Cleaning Plant	14.25
Tipple	2.35
Ventilation	2.07
Mining Machines	5.95
Mechanical Loading	4.76
Gathering Locomotives	11.89
Haulage Locomotives	14.27
Drainage	2.64
Substation Conversion and DC Transmission Losses	21.11
AC Transmission, Transformer Losses and Tenement Lights	20.71
Total	100.00

This report, covering actual analyses of power uses made at three operating coal mines, is submitted to the committee by J. O. Cree, West Virginia Engineering Co.



POWER DISTRIBUTION—"Mine B"

98,000 Tons per Month

	Percent
Substations	30.90
Ventilation	33.00
Tipple	7.50
Drainage	11.20
Hoists	5.80
Losses	11.60
Total	100.00

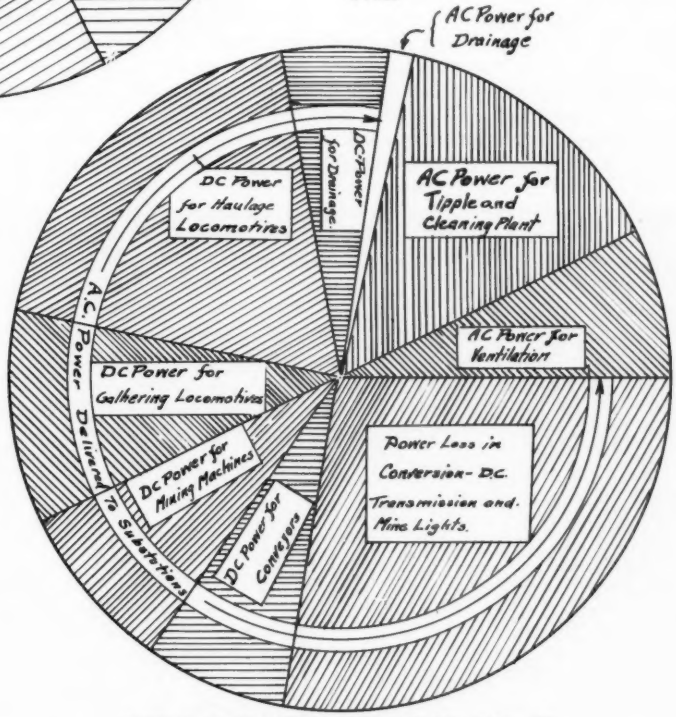
countered which is responsible for the high proportion of power used in ventilation. The principal pumps delivering water to the surface are all furnished with alternating-current power, but there are many gathering pumps in the working area of the mine that are furnished power from the direct-current mine system.

Mine C is another drift mine. Alternating-current power is furnished to four principal classes of equipment; namely, substations, a-c drainage pumps, ventilating fans, and a combined service for the tipple and cleaning plant. At this mine about 20 percent of the coal produced is from a section where conveyors are used.

The studies at Mines A and C were completed in more detail than at Mine B, as the segregation of the d-c power, after it had been converted by the substation, was made by special tests. For mobile units, such as mining machines, haulage and gathering locomotives, the power consumption has been determined from tests that were converted to a basis of average use per ton. Other electrical loads on the direct-current power system were measured by instruments and the average monthly use was then calculated.

Direct comparisons between the three mines cannot be made readily because of the difference in operating conditions, and these charts show some of the variations that exist. These charts and their accompanying tables present one way of analyzing the power use or distribution of electrical energy to the various classes of equipment. If more operators would study the distribution of power to the various classes of equipment the power costs for mining coal could be reduced. After the meters are installed it is a simple matter to make the calculations that are necessary to determine the power used by each class of equipment.

Submitted October, 1940, by J. O. Cree.


AC Power for Drainage
DC Power for Drainage
DC Power for Haulage Locomotives
AC Power for Tipple and Cleaning Plant
AC Power for Ventilation
A.C. Power Delivered to Substations
DC Power for Gathering Locomotives
DC Power for Mining Machines
DC Power for Conveyors
Power Loss in Conversion-DC. Transmission and Mine Lights.

ACTUAL MINE POWER DISTRIBUTION—"Mine C"

70,000 Tons per Month

	Percent
Ventilation	7.24
Tipple and Cleaning Plant	14.14
Drainage AC Power	1.12
Drainage DC Power	5.15
Haulage Locomotives	19.02
Gathering Locomotives	10.30
Mining Machines	8.25
Conveyors	6.97
Substation Conversion, DC Transmission Losses and Mine Lights	27.81
Total	100.00

Note: Actual Mine Power is approximately 77 percent of total power purchased. Remaining 23 percent is used for non-mining purposes

WHEELS of Government

● *As Viewed by A. W. Dickinson of the American Mining Congress*

EARLY in October both the Senate and the House of Representatives arranged for a series of three-day recesses with the understanding that no controversial legislation would be acted upon, and that if an emergency arises, absent members would be protected by full and sufficient notice in order that they might return to Washington. Approximately one-third of the Senators and practically all of the Representatives in Congress have felt the urge to go home to campaign for reelection in their respective districts. This they could hardly do while the Asiatic situation was so crucial, but the conciliatory attitude of Japan following the stern measures taken by Great Britain and the United States changed the picture for the time being.

At this writing all eyes are turned toward the election on November 5. There was an interesting sidelight on the day before labor leader John L. Lewis made his speech in support of Presidential candidate Wendell Willkie. Apparently in response to the desire of the National Democratic Committee to salvage a part of the coal miner vote, the White House announced approval of the Neely Federal Mine Inspection Bill and urged House leaders to expedite its passage. Observers drew the inference that the President regretted the undignified action of the national committee when Secretary Ickes, who frequently speaks for the President, came out almost immediately with the statement that the Neely bill was pretty well blocked in the House committee.

Taxation

On October 8, 1940, at 11:00 p. m., the President approved the excess profits tax bill which as public law No. 801—76th Congress, also includes the new amortization provisions. Again it is believed the coming election holds the key to the policy on revenue legislation which will be followed by the new Congress convening in January. Most observers believe that if Mr. Roosevelt is reelected an immediate rewriting of the present law will take place in January and February but that if Mr. Willkie wins there will be no immediate revenue bill.

Early in October there were reports of a flurry over the domestic supply of copper and of a threat on the part of a Federal official that the import excise tax of 4c a pound might be reduced by executive order. Concern was felt by producers of domestic copper over the possibility of large imports of South American copper—a concern similar to that in the minds of domestic wool growers over the prospect of large shipments of Australian wool.

National Labor Relations Board

No Administration appointment has been made to the National Labor Relations Board to take the place of Chairman Madden whose term of office expired in early September, nor has there been any action by the Senate Committee on Education and Labor on the Smith amendments to the Labor Relations Act, which were approved months ago by the House of Representatives. The election seemed to be the key to the situation.

A furore was created early in October when Attorney General Robert Jackson ruled that decisions of the National Labor Relations Board are binding on other Government agencies until reversed by the courts. Laborite Sidney Hillman of the Defense Commission immediately announced that the War and Navy Departments and the National Defense Commission would follow the policy of making Federal labor law compliance a condition for the letting of Government contracts. The House committee investigating the National Labor Relations Board, under the chairmanship of Howard W. Smith of Virginia, immediately called a hearing and inquired of witnesses if the Defense Commission and the Army and the Navy must consider compliance with Labor Board rulings a prerequisite in awarding defense contracts. Among those testifying were Navy Secretary Frank Knox, Assistant Secretary of War Robert Patterson and Attorney General Jackson. It was announced at the conclusion of the hearings that although the Defense Commission may consider the compliance or non-compliance by contractors with Federal labor laws, the commission will give weight primarily to the pressing need for expediting the production of needed articles.

Rugged and able Defense Commissioner Knudsen, who has the terrific job of stimulating production under the defense program, gave his views of the position of the commission in speaking before the Army Ordinance Association in New York on October 8, when he told his audience that the work carried out under the defense program should comply with Federal labor laws wherever such provisions are applicable. He further said: "This means to me that when the courts have held that labor practices followed by a manufacturer violate the laws of the land, then as a matter of policy only defense contracts should not be given to that manufacturer until he changes his practices, and that's all it means to me."

Wage-Hour

Under the provisions of the Fair Labor Standards Act of 1938 the 40-hour week was ushered in on October 24, 1940. It is believed that while more hours may be worked upon payment of one and one-half times the regular wage rate, the tendency through the years will undoubtedly be toward the 40-hour week as an industrial standard. The difficulties encountered by those charged with the administration of the act are mounting as it is understood that the Wage-Hour Division has before it over 30,000 complaints which require handling under present routine procedure.

On the 14th of October the division announced the redefinition of the terms, "executive," "administrative," and "professional" employes and "outside salesmen." These redefinitions were made as the result of petitions and hearings which covered a period of several weeks in May and June, at which time representatives of the

American Mining Congress presented the views of the mining industry. As announced by the division the term "executive" is to apply to a person "who is a boss over men" and who manages an establishment or a subdivision thereof, directing the work of other employes. He must regularly exercise discretionary powers and receive a salary of not less than $30 per week. An administrative employe is one "who establishes or effects or carries out policies but who has little or no authority over the specific actions of individuals." He must receive a salary of not less than $200 per month and must regularly assist or advise an administrative or executive employe but such assistance must be of a nonmanual character and require "the exercise of discretion and independent judgment." The classification of "professional" employe requires that the work which he performs must be predominantly intellectual and varied in character, requiring consistent exercise of discretion and judgment. His work must further be of such character that the output produced or the result accomplished cannot be standardized with relation to a given period of time. His salary must be at least $200 per month and his classification is based upon work of an advanced type or of an original or creative nature. His salary of $200 per month does not automatically create an exemption from the provisions of the act but must be accompanied by the observance of the other requirements under this definition.

St. Lawrence Power

Rumors of the Great Lakes-St. Lawrence seaway and electrical power project's revival by the Administration which have been current for several months were crystallized recently by a Presidential message to Congress announcing the appointment of a special committee to study the development of electric power in the International Rapids section on the northern border of New York State. Extolling the necessity for action as a defense measure, the President placed $1,000,000 of the $200,000,000 of "blank-check" funds given him by the Congress at the disposal of the U. S. Army Corps of Engineers for surveys and investigations. The State Department advises that the Government of Canada and the United States are acting jointly in order that the entire project may be started without loss of a favorable construction season.

Those who are opposed to the St. Lawrence project because of its harmful effect on the industries of the Great Lakes Basin and adjacent areas see in the action taken at this time a move to put over a pet Administration project under the guise of national defense. Normally such a program could not be entered into without the consent of the Senate to an enabling treaty, but the joint defense status of Canada and the United States has apparently made it possible for the Administration to proceed toward its desired end.

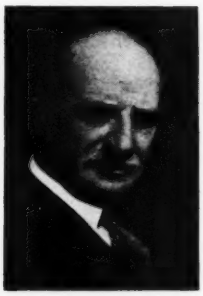
Strategic Minerals

As the result of surveys of domestic stocks and production facilities the National Defense Advisory Commission has announced that stocks of tin, manganese and zinc are adequate for present defense demands and attention is now being given to the encouragement of production facilities, expansion of plants, locating new sources of ore and guarding existing stocks by controlling exports through licensing. Imports of manganese from Cuba are to be materially increased and the Metals Reserve Company (RFC) has made a contract of purchase with tin producers in Bolivia for concentrates sufficient to yield 18,000 tons of fine tin per year for five years. The recent survey of domestic zinc stocks indicates that producers' stocks were decreased by 50 percent between April and September of this year while consumers' stocks decreased only 13 percent in the same period. The licensing of exports of steel and iron melting scrap which has resulted in cutting off shipments to Japan has resulted in stabilizing the scrap situation for the steel industry.

A priority division has been set up within the Defense Commission consisting of William S. Knudsen, Edward R. Stettinius, Jr., Leon Henderson and Donald M. Nelson, who is functioning as procurement coordinator. The division will work with the Army and Navy in determining priorities to best meet the needs of the defense program. Another phase which will undoubtedly enter into the division's work in the future will be the consideration of priorities for raw materials producers, who will find themselves in need of motors and electrical equipment, wire rope, steel rails, copper wire and cable, and other equipment and materials necessary to production.

PERSONALS

T. R. Johns has been made vice president of the Industrial Collieries Corporation, coal producing subsidiary of the Bethlehem Steel Corporation. His appointment was announced at a meeting of the Bethlehem Steel Corporation directors October 29.



Mr. Johns has been general manager of the Industrial Collieries Corp. for a number of years and will continue to act in that capacity, in addition to his new duties. He has been prominent in the development of Central Pennsylvania coal fields and is a noted authority on mining practices. He is chairman of the Pennsylvania program committee for the 1941 Coal Convention and Exposition of the American Mining Congress.

K. G. Link has been appointed superintendent of the Bishop, Calif., mine of the U. S. Vanadium Corporation. He was formerly superintendent of the Hidden Treasure Mine of the United States Smelting, Refining and Mining Company at Ophir, Utah.

John L. Auch has been elected treasurer of the Pittsburgh Coal Company succeeding William McPherson, retired. Mr. Auch, who was assistant treasurer, came to the Pittsburgh Coal Company in 1939.

R. B. Henley has been elected auditor of the Oliver Iron Mining Company, Duluth, Minn., succeeding William J. O'Connor who has retired. Mr. Henley was formerly auditor and secretary of the Michigan Limestone & Chemical Company at Rogers City, Mich.

C. W. Gibbs, formerly general manager of the Harwick Coal & Coke Company, has announced the dissolution of that company. Coal operations are now being directed by the Duquesne Light Company, and Mr. Gibbs is general superintendent of that company's coal department.

I. S. Gillespie has been appointed mining engineer by the National Coal & Coke Company. He will be located in Walker County, Ala.

George L. Spencer, Jr., has been appointed general superintendent of the East St. Louis, Ill., plant of the American Zinc, Lead & Smelting Company. He previously was manager of the company's zinc sulphide division.

Ralph F. Overly has been appointed mine superintendent for the Maryland New River Coal Company in Winona, W. Va. He was formerly employed by the Gauley Mountain Coal Company.

W. M. Black has been appointed president of the American Manganese Steel Division of the American Brake Shoe and Foundry Company.

Mr. Black became general sales manager of this division in 1934 and a vice president in 1935. He has been with the "Amsco" since 1912 with the exception of the war years when he served as a lieutenant in the U. S. Ordnance Department.

Roger H. Clapp and **Earl N. Graf** have been promoted to new positions in the John A. Roebling's Sons Company.

Mr. Clapp has been appointed assistant general manager of sales for the company and Mr. Graf has been made assistant manager of sales of the Wire Rope Division. Both men

Roger H. Clapp

Earl N. Graf

will make their headquarters at Trenton, N. J.

Prior to their promotion, Mr. Clapp served as manager of the Philadelphia branch and Mr. Graf was in charge of the Pittsburgh branch.

Edward J. Quintal, a vice president of the Chase National Bank, was elected a director of United Electric Coal Companies at the annual meeting of stockholders. At a subsequent directors' meeting **A. M. Foehrer** was elected assistant secretary and **C. N. Strong**, formerly assistant secretary, was elected assistant treasurer.

Dr. C. J. Potter has resigned as assistant chief of the marketing section, Bituminous Coal Division, to join the staff of the Rochester and Pittsburgh Coal Company.

Roy Ratliff, formerly assistant to Ben Davis, vice president in charge of operations of the Sloss-Sheffield Steel & Iron Company, has been appointed general manager of the company's coal mines.

I. W. Miller has resigned as chief of the coal mining department of the Tennessee Coal, Iron & R. R. Company to accept an appointment as general superintendent of mines for the Black Diamond Coal Mining Company and associated companies in Tennessee and Alabama.

—*Obituaries*—

Oliver H. Shoup, 71, governor of Colorado for two terms from 1918 to 1922, for many years a prominent mine operator and oil developer, died in Santa Monica, Calif., where he had been living recently in an effort to regain his failing health.

He is survived by his wife, Mrs. Unette Small Shoup; three sons, Merrill and Verner Shoup, both of Colorado Springs, and Oliver H. Shoup, Jr., and a daughter, Mrs. John Leeming, Jr., of Denver.

Henry H. Timken, Sr., 72, cofounder of the Timken Roller Bearing Company, died of pneumonia at the Timken estate, Canton, Ohio, on October 14.

Mr. Timken was chairman of the board of the company.

Almon L. Bailey, vice president and treasurer of Butte Copper & Zinc Company, died at his home in Ridgewood, N. J., following an extended illness.

Morrison Mills, eastern district manager of the construction equipment division of Chain Belt Company, of Milwaukee, died recently in Philadelphia, Pa., where he made his home.

Mr. Mills was service manager of the construction equipment division of the company from 1931 to 1937, and eastern district manager since that time.

Henry Howell Armstead, 68, consulting mining engineer and retired major of engineers, U. S. A., died recently in Vancouver, B. C.

He was the son of Henry H. Armstead of New York, mining engineer, and Alice McPherson Armstead, and was a graduate of the Columbia School of Mines. He was a member of the American Mining Congress, the American Institute of Metallurgical Engineers, and of similar bodies in Canada and South America.

NEWS and VIEWS

Ickes Denies Carter Coal and Associated Industries Petitions

Secretary of the Interior Harold L. Ickes has denied petitions filed by the Associated Industries of New York State, Inc., and the Carter Coal Company of New York requesting the suspension of minimum prices and marketing rules established by the Bituminous Coal Division on October 1 and the reopening of proceedings for their reconsideration.

The Associated Industries attacked the cost determination of $2.12 per ton used by the division in establishing minimum prices for coals produced in Price Area 1, the Appalachian field, which supplies coals consumed by the association's members. The association, made up of industrial and commercial concerns in New York State, contended the figure was illegally determined, and not based upon adequate information.

The Carter Coal Company attacked the minimum prices and marketing rules as a whole, but specifically objected to certain prices and regulations applying to its own coal shipments.

Secretary Ickes, in his orders refusing to reopen the three-year-long price establishment proceedings, said that all of the issues raised by both complainants had been thoroughly considered, some of them by the National Bituminous Coal Commission, the division's predecessor, and all of them by Division Director Howard A. Gray and reviewed by the secretary himself.

Only the Associated Industries and the Carter Coal Company have filed petitions with Secretary Ickes asking for suspension of the minimum prices and reopening of the proceedings, which were completed on October 1 after having been in almost constant process for more than three years. The division, however, has acted, or is in the process of acting, upon numerous requests for adjustments of the minimum prices and marketing rules to fit specific situations or to set up minimum prices for producers who joined the code too late to get their prices in the initial schedules.

Secretary Ickes stated in his order that the petition filed by the Associated Industries had no merit either for suspending the prices or setting aside the cost determination upon which the minimum prices for coals consumed in New York were based. He said that the cost determinations for all areas had been reconsidered by Director Gray and himself and "were found and determined to be correct and proper in all respects." He pointed out numerous instances where the issues raised by the association had been brought up and considered during the price establishment procedure.

In his order denying the Carter Coal Company's motion, Secretary Ickes said: "There is no showing whatever in the petition or otherwise of immediate possibility of injury to petitioner, or of any other urgent circumstances that would require or justify the granting of a temporary stay of the effective minimum prices and marketing rules and regulations pending determination of this petition. And, considered upon its merits, the petition should be denied."

Listing the many occasions upon which the questions raised by the Carter Company had been considered in the process of establishing minimum prices and marketing rules, Secretary Ickes said: "No showing has been made in the present petition to justify rehearing or reargument of these matters, which have been the subject of such repeated and exhaustive hearing, argument and disposition; nor is there anything in the petition which alters my opinion that my findings of fact and those of the director relating to the contentions of petitioner are proper.

"The effective minimum prices and marketing rules and regulations established in Docket No. 15 are specifically made subject to modification, alteration, addition, or any other change which may be made in accordance with Section 4 II (d) of the Act. Petitioner's contentions may be fully heard and considered in such a proceeding."

Eagle-Picher Sinking New Shaft Near Cardin, Oklahoma

Sinking of a new shaft on the Blue Goose lease, south of Cardin, which was started several weeks ago by the Eagle Picher Mining and Smelting Company, is approximately two-thirds completed in depth.

Site of the shaft sinking development is nearly mid-way between the See Sah and Southside mines now being operated by the company. The new shaft, which will be 5 by 7 ft. in the clear, will be sunk to the 325-ft. level.

Completion of the shaft will afford a new outlet for handling increased tonnages of ores mined from the sheet-ground formation of the immediate area.

Grading has been completed by the company for the laying of some 5,800 ft. of railroad trackage from the Central mill yards to the new shaft and to See Sah No. 3 mine shaft.

Construction of a 50-ton-an-hour Joplin-type mill by the company on the Navy Bean lease, between Wentworth and Diamond, has shown considerable progress, and is expected to be ready for operation some time in November.

New Tungsten Property Established

B. R. Tillery, president of the Ima Mines Corporation, has announced the discovery of a new tungsten property in the Blue Wing mining district of Lemhi County, Idaho.

The new discovery is on the opposite side of the canyon from the company's Ima mine and is presumably on the same vein structure. Mr. Tillery has stated that the new vein has been opened with a drift about 175 ft. long showing a body of ore of commercial size and which assays have shown to give the returns of 1½ percent tungsten.

It is reported that the new ore is better than that produced by the older mine which is said to assay less than 1 percent WO3 but in addition to the tungsten the old mine carries some copper and other minerals produced and shipped to the Salt Lake smelters.

Mr. Tillery stated that the appearance of the new strike would indicate that the company will be able to increase its present production to possibly 50 percent more as soon as transportation can be provided to get the ore to the mill.

Illinois Coal Operators Association Holds Annual Meeting

The Illinois Coal Operators Association held its 12th annual meeting in Chicago on October 29 and elected the following as members of the Executive Board:

D. W. Buchanan, president, Old Ben Coal Corporation.

H. E. Howard, president, Pyramid Coal Corporation.

T. C. Mullins, president, Sunlight Coal Company.

M. F. Peltier, vice president, Peabody Coal Company.

L. D. Smith, vice president, Chicago, Wilmington & Franklin Coal Company.

T. J. Thomas, president, Valier Coal Company.

W. P. Young, vice president, Bell & Zoller Coal Mining Company.

C. W. Peterson was elected treasurer. Following the general meeting, the Executive Board met and re-elected M. F. Peltier as its chairman. The Board also re-elected the following officers and general counsel for the ensuing year: President, M. F. Peltier; secretary, Fred S. Wilkey; general counsel, Thurlow G. Essington.

WEST VIRGINIA MINING MEN AND ENGINEERS HOLD JOINT ANNUAL SESSIONS

West Virginia mining men and engineers enjoyed a 3-ring feature in the joint annual meetings of the West Virginia Coal Mining Institute, West Virginia Coal Conference and West Virginia Society of Professional Engineers at Morgantown, October 17, 18 and 19.

Highlighting the joint program was the official ground-breaking ceremony for the new Mineral Industries Building at the state university, led by Governor Homer A. Holt and Dr. Charles E. Lawall, president of the University. The construction of the Mineral Industries Building is the result of years of work on the part of mining leaders to provide adequate research facilities for the state's coal and other allied industries. It also greatly improves the present facilities for college training and the mine extension classes conducted by the School of Mines. The new building will be ready for occupancy about January 1, 1942, and will house the School of Mines, the chemical engineering department and the State Geological Survey.

Charles W. Connor, president of the Institute, welcomed all the visitors and presided at the opening session. "Losses in Coal Preparation" was the subject of the first paper, by Byron M. Bird of the Battelle Memorial Institute. (See page 29 of this issue for complete paper.)

Problems of screening bituminous coal were discussed by G. R. Delamater, assistant vice president, The W. S. Tyler Company, who cited the wide variations in preparation practice and sizes produced throughout the country. Pointing out that shaker screens have always dominated bituminous coal tipples, because for many years no effort was made to screen below 1¼ in., 1 in. or ¾ in. round coal and such screens lend themselves nicely to ordinary tipple construction, he added that the high percentage of slack coal plus falling slack coal market prices created a desire for finer mesh screening. For such separation, the shaker screen proved inefficient under normal conditions as regards surface moisture content and vibrating screens of various types have been developed which have made it possible to screen to as fine as 28 mesh without the need of drying coal. This paper avoided the technical and presented the more practical side of screening through discussions of screen capacities, screen efficiency factors and the general practices of modern coal screening.

"Keeping the American people warm is a large undertaking and involves several huge industries," asserted C. E. Lesher, president, Pittsburgh Coal Carbonization Company, opening a paper on "Keeping Warm." He reviewed the fuels with which we keep warm, analyzed the trend toward automatic heating and concluded that after automatic heating had done its best, there will remain an overwhelming majority of homes that will be hand-fired with solid fuel. Reviewing the obvious advantages shown by each of the several fuels used for keeping warm, he stated "Rising standards of keeping warm have forced the coal producer to participate in this business of better ways to heat homes, notwithstanding the complication that forced participation is introducing into the production, cleaning and sizing of his coal. Progress in the business of keeping warm is affecting even the hand-fired solid fuel industry. There are gains to be made in economy, convenience and cleanliness for the big majority who hand-fire their fuel. This field is hardly touched."

"The hand-fired solid fuel industry has yet to meet the challenge of smoke conscious communities. Carbonization of coal is the only proven method of taking the smoke out of soft coal whether the process be high temperature, medium temperature or low temperature carbonization. The next forward movement in coal carbonization will get its impetus from the demands for smokeless, hand-fired fuel and the pressure for an economic use for the undersized fine coals resulting from double screening stoker sizes. The processes that are and will be used are these that will give the most acceptable domestic fuel at the lowest cost of conversion from the nearest available coal supply."

In a paper entitled "Trends in Coal Preparation in Burning Equipment," E. G. Bailey, Babcock and Wilcox Company, reviewed what is happening in the various markets for West Virginia coal, and what are believed to be the trends in the near and more distant future. He asserted that in the long run coal must be prepared and supplied to meet the needs of the coal burning equipment because much of this equipment is so far from being perfected that coal of special quality and preparation must be supplied for a satisfactory performance. "So long as equipment with such limitations exist, the tendency for the cost of preparing and supplying suitable coal is likely to be high and greater competition will exist between the oil and gas fuels, which have greater uniformity of quality and characteristics. The ideal furnace and fuel burning equipment is one which will efficiently burn coal of any rank or grade or quality with a minimum of variation in overall cost; in other words, one which will produce steam in a given locality at the lowest cost based on the mine price plus transportation charges plus power plant operation and fixed charges. The consumer will ultimately decide the relative price he can and will pay for different kinds of coal or other fuels. Their prices will be determined by the results he can obtain from them when burned in the equipment he has in his plant. When it is to his advantage to change the equipment or discard old boilers and methods of firing and buy new, he will do so." He suggested that one form of research which the bituminous industry could well consider would be along the lines of statistics as to the actual fuel consumption in different kinds of equipment and the anticipated trends.

A review of the problems relating to dust-proofing coal was presented by Reed Scollon, research fellow, West Virginia University, who cited dust-proofing as being now widely accepted as a solution to the problem of making coal a really fine fuel. Oils and hygroscopic salts are the principal materials on the market for allaying dust, he advised, and after outlining the claimed advantages and disadvantages of various treating methods he concluded "It is hoped that continued and extended studies will bring out the facts, and eliminate much of the guesswork predominating in coal treating today."

"Some Applications of Research to West Virginia's Natural Resources" was the subject of a paper presented by W. W. Hodge, West Virginia University, in which he reviewed the status of industrial development within the state and pointed out how the new research facilities at the university could be best applied. Dr. C. E. Lawall, president of the University, and D. L. McElroy, director, School of Mines, described the new Mineral Industries Building, and discussed the application of the university's research program to the future of the state's coal industry.

The annual banquet of the combined groups was held on Friday evening with U. S. Senator M. M. Neely; Dennis Chapple, assistant to the president, American Rolling Mill Company; M. L. O'Neale, president, West Virginia Society of Professional Engineers; President Charles E. Lawall of the University as speakers. Robert Williamson, Jr., presided as toastmaster.

W. G. Crichton, vice president in charge of operations, Johnstown Coal and Coke Company, was elected president of the Institute, succeeding C. W. Connor, superintendent of mines, American Rolling Mill Company, who was named to the executive board.

Other officers chosen are: T. E. Johnson, J. T. Sydnor, Max Forrester, Harry Faust and Joseph Pursglove, Jr.—all vice presidents; D. L. McElroy, secretary-treasurer; and R. J. Burmeister, Carel Robinson, N. P. Rhinehart, F. F. Jorgenson, members of the Executive Board.

Zinc Institute Publishes Booklet on Industry

The American Zinc Institute has recently issued a new publication describing the zinc industry from mine to market. The publication is entitled "The Zinc Industry" and describes in simple terms the history of zinc, its uses, production and processes, and market.

An earlier edition was published in 1932 and was widely disseminated to educational institutions, students, and the public.

Copies may be obtained free of charge upon written request to the American Zinc Institute, Inc., 60 East 42nd Street, New York, N. Y.

Possibilities of Manganese Production at Leadville, Colorado

The possibilities of manganese production at Leadville, Colo., are considered in a report recently published by the U. S. Bureau of Mines.

In connection with the Strategic Minerals Investigations now being conducted, consideration was given to the Leadville area as a possible source of manganese that might be made available for use under circumstances of national emergency. It appeared, however, that because many of the mines were shut down and flooded, the information desired could not be obtained directly by sampling. A study of evidence afforded by maps and production records, considered in connection with geological reports, promised a more satisfactory, if not the only possible, approach to the problem.

The local claim that reserves of 16 to 25 percent manganese ore exceed 2,000,000 tons may be accepted. How much of this is recoverable is problematic because of the physical condition of the mines.

Rehabilitation of the mines is contingent upon greatly improved markets for lead and zinc that would offer sufficient inducement to undertake the costly and speculative venture of unwatering and reopening long abandoned and doubtless badly caved workings in an area noted for heavy ground.

Complete drainage by pumping would cost close to a million dollars and would take two years. A proposed drainage tunnel, 38,000 ft. in length, including laterals, would drain the principal areas to a level below most productive horizons at a cost of from 2 to 2½ million dollars and would require a minimum of two to three years to complete.

Recent activity has shown that reserves of manganiferous iron ore containing 15 to 25 percent manganese exist above water or are accessible with a moderate amount of pumping, and that this ore can be mined to yield a small profit at a net price f. o. b. mine, of $6 to $7 a ton. Given an assured market at a slightly higher price, it is believed that 100 tons a day of this grade of ore would be produced. Failing general reopening of the mines due to other influences, it is doubtful whether manganese output could be raised much above this figure.

Coal Mining Institute of America to Meet in Pittsburgh

The 54th annual meeting of the Coal Mining Institute of America will be held at the Fort Pitt Hotel, Pittsburgh, Pa., on December 12 and 13.

Dr. R. R. Sayers, director of the U. S. Bureau of Mines, will make the principal address at the annual dinner on the evening of December 12.

Tin Smelting Committee Appointed

A technologic committee on tin smelting has been appointed by E. R. Stettinius, Jr., member of the National Defense Advisory Commission in charge of the Industrial Materials Division, and by the Metals Reserve Company, a subsidiary of the Reconstruction Finance Corporation. The personnel was recommended by the National Academy of Sciences.

The purpose of the committee is to review the eight proposals which have been submitted to Metals Reserve Company for the building of a tin smelter in this country as part of the preparedness program and to recommend the selection of one of them. The committee is beginning its work in Washington at once.

The members are: Clyde Williams, director, Battelle Memorial Institute, Columbus, Ohio (chairman); Walter C. Smith, Metallurgist, Cerro de Pasco Copper Corporation, New York City; John F. Thompson, executive vice president, International Nickel Company, Inc., New York City; and F. W. Willard, president, Nassau Smelting & Refining Company, New York City.

Sunshine Opening Deep Mine Level

Sunshine Mining Company is reported to be driving a new crosscut to the Sunshine vein system from the 3,700-ft. level of the mine. This crosscut will give the company 600 ft. of new stoping ground below its present lowest mining operations on the 3,100 level. One thing of particular encouragement to the Sunshine is the fact that on the 3,100 level at least two new veins of commercial grade silver ore have been found that were not in evidence in the upper levels. These two veins have been developed sufficiently to indicate considerable increase in the available tonnage of the mine.

Consolidation Coal Company Undertakes Management of the Elk Horn Coal Sales Corporation

A joint announcement has been made by the Consolidation Coal Company and the receivers for the Elk Horn Coal Corporation that after October 1 sales of all coal mined or controlled by the receivers for the Elk Horn Coal Corporation will be made through the Elk Horn Coal Sales Corporation. This company will be under the sole management and direction of Consolidation Coal Company.

Unfilled spot orders and contracts for "Fleming," "Wayland," or "Hi-hat" coals, previously placed with the Elk Horn Coal Corporation, which had been accepted and affirmed by the receivers, have been turned over by the receivers, to the Elk Horn Coal Sales Corporation. Immediate steps are being taken by this company to consult customers concerning these orders. All inquiries will receive prompt attention and should be addressed to the Elk Horn Coal Sales Corporation at its various district offices located at 2432 Buhl Bldg., Detroit, Mich.; 410 So. Michigan Ave., Chicago, Ill.; 4102 Carew Tower, Cincinnati, Ohio; and 1123 Midland Building, Cleveland, Ohio.

Bunker Hill Plant Enlarges Capacity

Announcement has been made by the San Francisco office of the Bunker Hill and Sullivan Mining & Concentrating Company that the company has increased its capacity of smelting and refining facilities 15 percent at the smelter and refinery plants at Kellogg and is now producing at the rate of 2,600 tons of lead and 140,000 ounces of silver per month. The Sullivan zinc smelter is producing 1,300 tons of 99.99 plus pure zinc each 30 days. Higher operations are due to the increased demand for lead and zinc. In addition to its own ores, the Bunker Hill smelter handles the lead-silver ores of the Hecla and Star mines and the silver-copper-bismuth-antimony ores of the Sunshine mine

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besides custom gold and other ores from all over Idaho and surrounding states. The Sullivan company's electrolytic zinc plant is one of the most modern plants of its kind. The Bunker Hill company's new bismuth-antimony smelter and refinery is the only plant in the nation with a process successfully separating bismuth and antimony from the rich tetrahedrite silver-copper ore of this district. This company is one of the few companies in the world that mines, mills, smelts, refines, manufactures, and sells its own metal products.

U. S. Chamber of Commerce Adopts Report on Natural Resources

Recommendations made by the Natural Resources Production Department Committee of the U. S. Chamber of Commerce, of which James E. Francis, president, Island Creek Coal Company, is chairman, were adopted at a recent meeting of the Chamber's Board of Directors.

These recommendations opposed regulatory legislation such as is embraced in the Guffey Act; opposed passage of the Mine Inspection Bill; charged that any serious power shortage in this country is remote; and reaffirmed the committee's stand of last year that petroleum conservation can best be attained through operation of state compacts.

Of the Guffey Act, the committee stated, "The Chamber has earnestly studied the provisions of this legislation and believes them to be unsound in principle and impracticable of operation. This Act has now been in force 41 out of the 48 months' life given it by Congress without having produced any benefit to the industry, or without having succeeded in putting into effect the regulatory and administrative measures which the Act proposes. Obviously Congress could not have contemplated any such labored supervisory program or type of control as would require practically the whole life span of the Act in its preparation.

"The membership of the Chamber have long recognized the need of some form of concerted action by the operators of the bituminous coal industry that would stabilize conditions without running afoul of the anti-trust laws. The Appalachian Coals, Inc., decision by the United States Supreme Court was an approval of the industry plan for concerted action through the means of 'marketing agencies.' This type of industry action has been endorsed by the Chamber's membership and should be given a trial without the encumbrances superimposed upon it by the Guffey Act regulations."

The Chamber reiterated its opposition to Federal bureaucratic control over matters which are properly the responsibility of the states as such control is proposed in the Federal mine inspection bill. "This bill," the chamber stated, "would initiate additional inspections and investigations of coal mines throughout the country, thus duplicating the work now being carried out by state agencies in cooperation with the United States Bureau of Mines, adding to the confusion of authority with which the industry is confronted and expanding unnecessarily Federal intrusion into state affairs.

"The passage of this Mine Inspection Bill the Chamber regards as unnecessary and undesirable as a safety measure in the bituminous coal-mining industry."

Galvanizers Committee Meets in Baltimore This Month

The Galvanizers Committee holds its fall meeting at the Lord Baltimore Hotel, Baltimore, Md., on November 14 and 15.

This is the eighth meeting of the committee, which is sponsored by the American Zinc Institute. Based on the attendance at the spring meeting, which was held in Pittsburgh, between 60 and 70 technical and operating men from the galvanizing departments of the 20 steel companies represented in the membership are expected in Baltimore this month.

On the first day of the meeting the Bethlehem Steel Company has scheduled a luncheon and plant inspection trip for committee members. Special papers are to be presented at the technical sessions on the second day and in addition there will be the usual round-table discussion of shop problems.

J. L. Schueler of the Continental Steel Corporation is the chairman of the governing board, and the program committee consists of N. E. Cook (chairman), Wheeling Steel Corporation, R. H. Dibble, Carnegie-Illinois Steel Corporation, and D. A. Russell, Youngstown Sheet & Tube Company.

Metaline Mines Work Full Blast

Shipments of concentrates from the Metaline district during the month of September were 45 cars. Shipments are now being made in large gondola cars carrying from 60 to 75 tons, so that the output of the district was in the neighborhood of 3,000 tons.

Pend Oreille Mines & Metals is continuing operation at full capacity and is now mining from a new ore body developed in the vicinity of Hidden Falls on Flume Creek.

This is a "grass roots" development, the ore being exposed by bulldozer and by hydraulic methods. The ore is hauled to the mill by truck. The Pend Oreille recently built a new road to the Sullivan claim, operated by it in the first World War, and will again mine from the claim.

Metaline Leasing has the Grandview mill in operation on a three-shift basis, supplied with ore from Metaline Leasing and Grandview mines.

On October 16 a new hour regulation goes into effect at the mines, time being limited to 40 hours a week. To meet the present demand for metals the mines will work 48 hours a week, paying the men time and a half for eight hours, an arrangement which is permitted by the law, and which the men favor.

Wages paid to the men are fixed in accordance with the prices for lead and zinc. October wage was $6.16 a day plus the Saturday overtime. If the present price of zinc remains at $7.25 a hundred the men will get another boost in their November pay checks. Pend Oreille Mines and Metals is now giving employment to 180 men and American Zinc Lead and Smelting Company has about 125 men in its Metaline Leasing and Grandview operations.

Air Hygiene Foundation Meets

The fifth annual meeting of Air Hygiene Foundation, held at Mellon Institute, Pittsburgh, November 12-13, insisted that the health of workers is as important as health of soldiers in girding America. Defense production, it contended, demands the defense of employe health.

Prof. Philip Drinker, of Harvard, headed a symposium high-lighting health safeguards in the mining, mechanical and chemical industries which bear the brunt of preparedness production. It will be recalled that in World War I, eight to nine men were busy in the mills keeping one soldier supplied at the front. Besides Prof. Drinker, chairman of the Foundation's Engineering Committee, participants in the symposium included:

Capt. Ernest W. Brown, senior medical officer, Brooklyn Navy Yard, Industrial Hygiene and the Navy in National Defense; Dr. P. A. Neal, National Institute of Health, The U. S. Public Health Service in the Defense Program; Dr. Howard W. Haggard, Yale University, noted health writer, Noxious Gases; Dr. Carey P. McCord, of Detroit, director, Industrial Health Conservancy Laboratories, Health Protection in Electric Welding.

L. Metcalfe Walling, administrator, Division of Public Contracts, U. S. Labor Department, outlined health requirements on Government contracts under the Walsh-Healey Act.

William P. Yant, research director, Mine Safety Appliances Company, Pittsburgh, talked on the protection of civilians in war time, especially from dangerous gases.

Reports were made on findings from Foundation-supported researches on industrial health problems, by Dr. L. U. Gardner, director, The Saranac (N. Y.) Laboratory; Dr. Eliot R. Clark, University of Pennsylvania, and Prof. Drinker, Department of Industrial Hygiene, Harvard University.

Dr. A. J. Lanza, of New York, chairman of the Foundation's Medical Committee, reported on industrial hygiene developments during the past year.

Dr. W. M. Gafafer, senior statistician, U. S. Public Health Service, made a progress report on the study of "Sick Absenteeism in Industry" which the Foundation is undertaking in collaboration with the Public Health Service and the Association of Industrial Physicians and Surgeons.

T. C. Waters, of Baltimore, member of the Foundation's Legal Committee, discussed latest legislation affecting

workmen's compensation for occupational disease.

Recent scientific developments in health protection of workers "passed in review" with emphasis on combating increased hazards from increased production.

Employment and Accidents At Lead and Zinc Mines, Mississippi Valley States, 1939

Employment at lead and zinc mines of the Mississippi Valley states in 1939, as shown by annual reports submitted by the operating companies to the Bureau of Mines, showed a decided improvement over 1938, but did not reach the high level of 1937.

The total number of men employed at the mines in 1939 increased 12 percent or 801 more than in 1938. The volume of work performed in 1939 was 12.4 million man-hours, a gain of 1.8 million or 17 percent over the previous year's figure. The average number of days worked per man per year increased from 207 in 1938 to 216 in 1939, the same as in 1937. The average length of shift, however, dropped from 8.03 hours in 1937 to 7.96 in 1938, and 7.95 in 1939.

The foregoing figures though relating almost entirely to lead and zinc mines, also cover fluorspar mines in Illinois and Kentucky at which 879 men were employed in 1939. Fluorspar mines in Illinois and Kentucky are included to permit publication of state totals for these two states and also because of similarity of accident hazards. Lead and zinc mines in the Mississippi Valley region, exclusive of fluorspar mines in Illinois and Kentucky, employed 6,358 men in 1939.

Accidents at the mines resulted in 15 deaths and 726 non-fatal injuries. A major disaster occurred in a mine in Kansas on January 31, 1939, and killed five employes. The fatality rate per million man-hours worked by the entire group of mines decreased from 1.42 in 1938 to 1.20 in 1939; however, if the major disaster were eliminated to show a more normal rate, the rate for 1939 would have been 0.80, thus comparing more favorably with the 1937 rate of 0.61. The non-fatal injury rate per million man-hours worked in 1939 was 58.32, slightly higher than the 1938 rate of 57.38.

The chief cause of accidents were falls of rock or ore from roof or wall, haulage, and rock or ore while loading at working face. These three causes accounted for 53 percent of the total number of injuries.

Marianna Smokeless Coal Company Starts Operations

The newly formed Marianna Smokeless Coal Company, a wholly owned subsidiary of the Pond Creek Pocahontas Company, began loading coal early in October.

Two new mines are located in the heart of Wyoming County, West Virginia, near Pineville. The mines were christened by Marianna Salvati, daughter of the vice president and general manager of the company. According to Mr. Salvati, these mines will be employing nearly 600 men by next spring.

General superintendent in charge of operations is William Crawford, who has been with the Pond Creek Pocahontas Company at Holden since 1927. David L. Francis, son of J. D. Francis, has been appointed assistant general superintendent, and J. B. Jansing has been made general manager of stores.

Forty-Eighth Annual Meeting Illinois Mining Institute

A near record-breaking group of over 300 mining men attended the forty-eighth annual meeting of the Illinois mining Institute at Springfield, Ill., on October 25.

M. M. Leighton

Problems of mine operation made up the day's program and in the evening the annual banquet was held at which R. L. Ireland, Jr., president of the Hanna Coal Company, delivered the main address.

An election of officers was held and the following were named to the executive positions: Dr. M. M. Leighton, Chief of the Illinois Geological Survey, president; J. A. Jeffries of the Illinois Terminal Railroad System, vice president, and B. E. Schonthal was re-elected secretary-treasurer. Dr. Leighton succeeds Roy L. Adams.

Action on resolutions was postponed until the Executive Board of the Institute meets later in Chicago.

Diamond Drilling and Conveyors

(*Continued from page* 21)

low a standard slusher block where cross transportation of the ore tended to minimize the cost of preparatory work and should have materially aided in reducing the overall cost of mining. In this particular area we felt that advantage could be taken of the greater carrying capacity of a conveyor. However, we had our usual run of wet muck and the conveyor was stalled and we were in distress because we did not only tie up production from one of the overlying slusher drifts but from three others also.

I do not know whether we can say definitely at this time that we would never be able to successfully use conveyors as there are other portions of our ore bodies which we will some day get to and mine and where conditions may be more favorable. We may venture a chance that the ground conditions in these new areas would not be too heavy and that we would not have the runs of wet and sticky ores.

Losses of Coal in Preparation

(*Continued from page* 33)

higher ash content are retained in the washed coal.

Acknowledgment

Grateful acknowledgment is made of the assistance of A. C. Richardson and Wm. J. Smith of the Battelle staff in the making of the calculations summarized in this paper.

C. & O. Adds to R. R. Property in Coal Fields

Service in the Raleigh County, West Virginia, coal fields has been extended by the Chesapeake & Ohio Railroad through purchase of the Kanawha, Glen Jean and Western R. R. Sale price of the latter road, which was built by the late William McKell to develop his coal properties, was $550,000. Authorized by the Interstate Commerce Commission, the purchase includes approximately 26 miles of single track and siding, and rolling stock.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

OF THE MINING CONGRESS JOURNAL, published monthly at Washington, D. C., for October 1, 1940.

City of Washington,
District of Columbia, ss:

Before me, a notary public in and for the state and county aforesaid, personally appeared B. E. Chambers, who, having been duly sworn according to law, deposes and says that she is the business manager of THE MINING CONGRESS JOURNAL, and that the following is, to the best of her knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in Section 411, Postal Laws and Regulations, printed on the reverse side of this form, to wit:

1. That the names and addresses of the publisher, editor, and business manager are:

Name of publisher, The American Mining Congress, Washington, D. C.

Editor, Richard J. Lund, Washington, D. C.

Business manager, B. E. Chambers, Washington, D. C.

2. That the owners are: The American Mining Congress—a corporation, not for profit. No stockholders. President, Howard I. Young, St. Louis, Mo.; Secretary, Julian D. Conover, Washington, D. C.

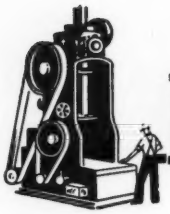
3. That the known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: None.

B. E. CHAMBERS,
Business Manager.

Sworn to and subscribed before me this 10th day of October, 1940.

ELSIE L. LEISHEAR,
Notary Public.

(My commission expires January 16, 1944.)



MANUFACTURERS' Forum

R&S Complete Several New Plants

Roberts and Schaefer Co., Chicago, Ill., announce contracts for and completion of the following plants:

Heisley Coal Company, Nanty Glo, Pa.—Crusher installation: capacity, 125 tons per hour; for reducing lump and egg coal to 1¼-in. slack.

Monroe Coal Mining Company, Revloc, Pa.—Crusher installation: capacity, 125 tons per hour; for reducing lump and egg coal to 1¼-in. slack.

Red Lands Coal Company, Glenside, Pa., No. 9 mine—Complete tipple and hydro-separator coal washing plant: capacity, 150 tons per hour of run-of-mine coal, with crushing and washing facilities to produce 3x1¼-in. egg, 1¼x⅜-in. stoker and ⅜x0-in. slack.

Red Lands Coal Company, Sides, Pa., No. 11 mine—Complete tipple and hydro-separator coal washing plant: capacity, 150 tons per hour of run-of-mine coal, with crushing and washing facilities to produce 3x1¼-in. egg, 1¼x⅜-in. stoker and ⅜x0-in. slack.

Chicago, Wilmington & Franklin Coal Company, West Frankfort, Ill., Orient No. 1 mine—Sump air-flow coal cleaning equipment for treating 7/16x0-in. raw coal at a feed rate of 175 tons per hour. These Stump units are of our latest 1940 design with adjustable air control, multiple refuse and middlings draw-offs.

New Jackhamer Jackleg

A new and novel air-feed rock drill mounting which is known as the Jackleg has just been announced by the Ingersoll-Rand Company. It is designed for use with Ingersoll-Rand jackhamers. This mounting helps to support the drill, absorb the recoil and feed it forward as the hole is drilled into the rock.

The larger and faster drilling jackhamers can now be used on horizontal holes. Instead of the operator holding up the drill by hand and pushing it forward as it drills into the rock, he uses the jackleg and only has to exert a slight downward pull on the handle of the jackhamer to balance the lifting force that is exerted by the pneumatic feed of the jackleg. The manufacturer of this jackleg reports that it increases drilling footage in some cases, as much as 50 percent. Also, the miners are less tired at the end of the shift and accidents are thereby reduced. Further claims are that rock drill upkeep costs are reduced, because there is less wear on the chuck bushings and fronthead parts.

The jackleg weighs only 35 lbs. and can be easily regulated by a conveniently located pressure throttle.

For additional information, an illustrated folder, Form 2690, is available from Ingersoll-Rand Company, 11 Broadway, New York City, or any of its branch offices.

Manhattan Rubber Buys Brighton Mills Property

To provide needed additional space for storage and steadily expanding manufacturing facilities, Raybestos-Manhattan, Inc., has purchased the Brighton Mills plant adjacent to the main plant of The Manhattan Rubber Mfg. Division at Passaic, N. J., according to an announcement made by F. L. Curtis, general manager.

The property includes approximately five and one-half acres on which are buildings with 240,000 sq. ft. of floor space. It is situated on the Delaware, Lackawanna and Western Railroad.

Bradley Announces Fixture Cleaner

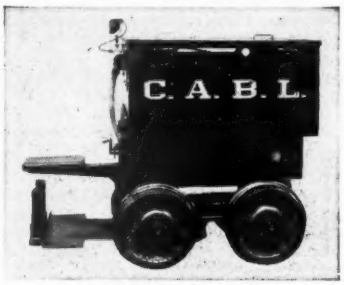
A new cleaning agent to be called Bradex is announced by the Bradley Washfountain Co., Milwaukee, Wis.

Developed especially for Bradley washfountains, multi-stall showers and drinking fountains, Bradex can be used on all washroom facilities. It is said to be economical, safe, easy to use, and highly effective.

Descriptive literature and prices will be supplied gladly upon request to this magazine or direct to the Bradex Department, Bradley Washfountain Co., Milwaukee, Wis.

Midget Storage Battery Locomotive

Of exceptionally rugged construction, a new midget storage battery locomotive, the actual dimensions of which are determined by the storage battery and the track gauge, is announced by the Westinghouse Electric & Manufacturing Company. The motor rests on a steel cradle which is



cast integral with the sections which house two worm drive units. The armature shaft is connected to the worms by means of torsion type coupling. With this type of construction the motor and couplings are relieved of all except torque stress. For additional information write to the Transportation Section, 2N, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Du Pont Develops Coal Cleaner

A new method of anthracite coal preparation, described as increasing efficiency and economy of operation, has been developed by minerals separation specialists of the Du Pont Company.

The equipment employed is a single-unit, multiple-stage classifier containing 10 individual hydraulic columns and two rotating zoners. Designed specifically for the production of Nos. 2, 3, 4 and 5 buckwheat sizes, the device will clean feeds ranging from closely sized materials to a comparatively broad-size range such as mixtures of rice and barley or No. 4 and No. 5 buck. The feed may be variable in composition, its source being either fresh run-of-the-mine coal or a silt bank.

The operating circuit is simple, Du Pont officials explained. For the production of rice or barley sizes, the feed, either mixed or separate, passes from the sizing screens over a shaking feeder to the machine. Four overflow products are delivered to a four-lane screen for dewatering and removal of small classified refuse.

The hydraulic columns of the machine are distributed around its circumference and the zoners, fitted with fins, carry material from column to column without disturbing classification. The zoners rotate separately at low speeds, one moving at a faster rate than the other.

For convenience, the columns are numbered from one to ten, beginning with the feed column, which has no upward current of water and may be considered a "static" column. The ninth and tenth columns, likewise static, are fitted with spigots at the bottom to discharge refuse. An automatic device, governing the rate of discharge, maintains the quantity of bed material recirculated and maintains a predetermined constant operating density.

The seven intermediate columns operate as individual upward current classifiers, the flow rate increasing successively in each. A launder collects the overflow products from the columns and combines them into four closely classified and sized fractions.

A high density fluid mass and agitated refuse bed are maintained in the machine, permitting the feed material to be more accurately classified with respect to density and less to particle shape. Particles are removed with upward currents equivalent to one-half their settling velocity.

When operating, feed material enters the first static column of the classifier where it is partially classified as it settles. From the feed column it is then carried by the zoners through each successive hydraulic column where upward currents complete the classification. Particles with settling characteristics requiring the use of high-velocity currents sink more rapidly in the feed column and are shunted to the most effective column for final classification. Each part of the feed, including all middling material, is delivered in its true hydraulic place as an overflow from one of the columns or as a bottom discharge from the machine.

Called "The Du Pont Fine Coal Cleaner," the device is a development of the Minerals Separation Division, The R. & H. Chemicals Department of the Du Pont Company.

New General Electric D-C Recorders

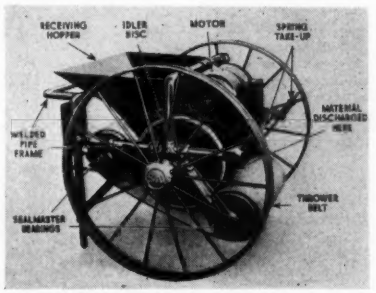
The General Electric Type CF line of inkless recorders has been extended to include direct-current instruments (Type CF2) available as voltmeters, ammeters, millivoltmeters, milliammeters, and even microammeters in ratings down to 125 microamperes full scale. These new CF2 instruments make it economical to apply recording instruments to many applications where previously the expense of suitable equipment could not be justified. Because of their inkless operation, they are ideal for general testing purposes and for use on moving machinery and for studying generator performance, battery load, and speed.

The CF2 recorder is portable, may be wall or pole mounted, and is suitable for indoor or outdoor application. Providing continuous operation for 30 days without attention, it is ideal for installation where frequent servicing is impractical. It may be operated at temperatures ranging from 10 to 120 degrees Fahrenheit.

The electric element of the CF2 is a concentric magnet d-c element, thoroughly shielded from stray magnetic fields. It is powered by a Telechron motor. The electric element, as well as all other moving parts, is housed in a modern, weatherproof case of aluminum-alloy casting. Accuracy is within 2 percent of full-scale value.

Improved S.A. Loader and Piler

Stephens-Adamson Manufacturing Company, Aurora, Ill., announce improvements in their S. A. Loader and Piler. These loaders are now equipped with Sealmaster permanently sealed, self-aligning, prelubricated ball bearing units. Due to the dusty conditions under which these machines normally operate in loading bulk materials into box cars and into piles, this improvement, it is said, is resulting in a minimum of maintenance attention and maximum power savings.



A new, simplified means of adjusting the alignment of the belt has been adopted. As shown on the photograph, this loader operates with a fast moving, dished belt. To facilitate adjustment of this alignment, a screw control now protrudes from the bearing through the front of the loader frame, so that to move the bearing forward or backward and thereby adjust the alignment, it is only necessary to turn this control to right or left with an ordinary wrench.

Pipe frame of the loader has been streamlined.

Further information will be furnished upon request to this publication or to the company direct.

CATALOGS AND BULLETINS

• BELT DRIVES. *The B. F. Goodrich Company*, Akron, Ohio. 170 pages "V-Belt Data Book" listing alphabetically belt requirements for water pumps, stokers and oil burners, gasoline pumps, air compressors and a number of other items. These listings give the manufacturers part number, the Goodrich belt number and its size in each case.

Twenty-four pages are devoted to numerical group listings of belt sizes, eight pages to a numerical list of belt dimensions both for V and flat belts, and 13 pages are given to conversion listings.

• CIRCUIT BREAKERS. *I-T-E Circuit Breaker Company*, Philadelphia, Pa. Catalogue 2501, "Type KSA and KSC Automatic Reclosing Circuit Breakers and Relays," describes and illustrates company's line of automatic reclosing circuit breakers and relays. 16 pages.

• COMPRESSORS. *Chicago Pneumatic Tool Company*, New York, N. Y. Bulletin 758 covers the company's line of portable compressors of streamlined design describing and illustrating each. Also includes description and illustration of a new 500-cu. ft. compressor powered by a Diesel engine. 28 pages.

• MILLING EQUIPMENT. *Deister Concentrator Company*, Fort Wayne, Ind. Bulletin 118 describes and illustrates the company's Super Duty Diagonal-Deck No. 6 Concentrating Table. Presents full information as to its advantages and specifications. 4 pages.

Hardinge Company, York, Pa. Bulletin 31-C describes and illustrates the company's line of Thickeners, Clarifiers and Agitators. Particular discussion is given to the company's newly developed "Auto-Raise" drive mechanism, a development in thickeners, which is described by the company in detail for the first time. 16 pages.

• PIPING ACCESSORIES. *Kennedy Valve Manufacturing Company*, Elmira, N. Y. Catalog 63 presents data on bronze and iron-body valves for low, standard, and higher pressures, standard bronze and malleable-iron screwed fittings, standard cast-iron flanged fittings and flanges, and various valve specialties. 240 pages.

• PUMPS—SAND. *Denver Equipment Company*, Denver, Colo. Bulletin No. P10-B describes and illustrates the Denver Vertical Centrifugal Sand Pumps. Outlines their uses and specifications. 4 pages.

• PUMP MOTORS. *Westinghouse Electric & Manufacturing Company*, E. Pittsburgh, Pa. A new 8-page illustrated booklet describes the company's line of bullet-type, vertical, hollow-shaft motors. These motors, available in squirrel cage, wound rotor or capacitor AC types, and also for DC operation, are designed for deep well turbine pumps.

• SCRAPER HOISTS. *Ingersoll-Rand Company*, Phillipsburg, N. J. Folder gives advantages and specifications of company's newly designed lightweight double-drum scraper hoist. 4 pages.

• SEAMLESS TUBING. *The Babcock & Wilcox Tube Company*, Beaver Falls, Pa. Technical Bulletin 11-C contains specifications established for carbon steel and alloy steel tubes by the American Society for Testing Materials and the Association of American Railways, and specifications established by the company for high chrome and stainless alloy tubes.

• VALVES. *Crane Company*, Chicago, Ill. Circular 312 describes the construction and use of Corrosion-Resistant Valves and Fittings, containing an 8-page section showing by convenient colored charts the resisting characteristics of various metals and alloys to about 200 corrosive chemical solutions used in various manufacturing processes. 56 pages.

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At right—Each circuit breaker controls a section, confining disturbances to the area in which they arise.

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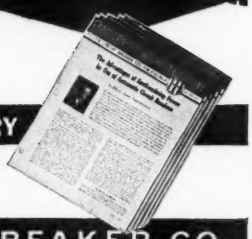

BULLETINS TELL THE STORY

These bulletins deal with a variety of mining conditions. Copies will be gladly furnished on request.

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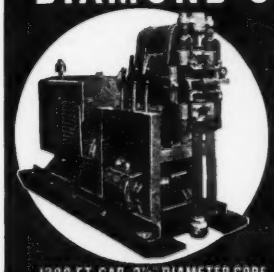

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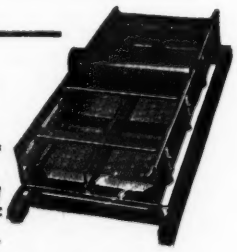

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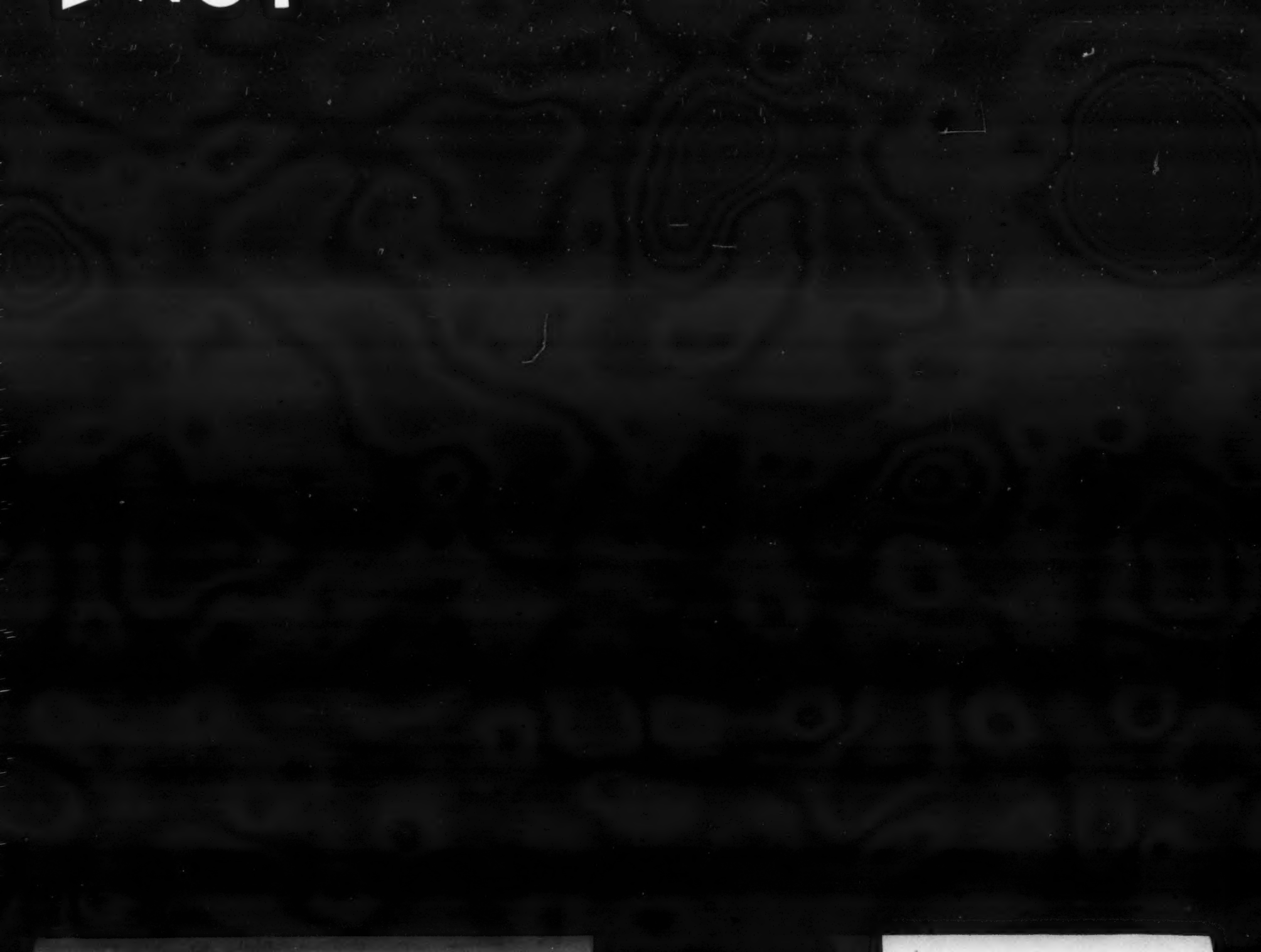
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